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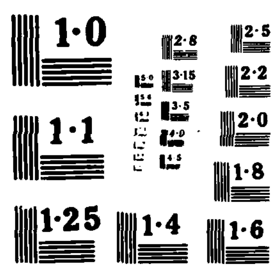
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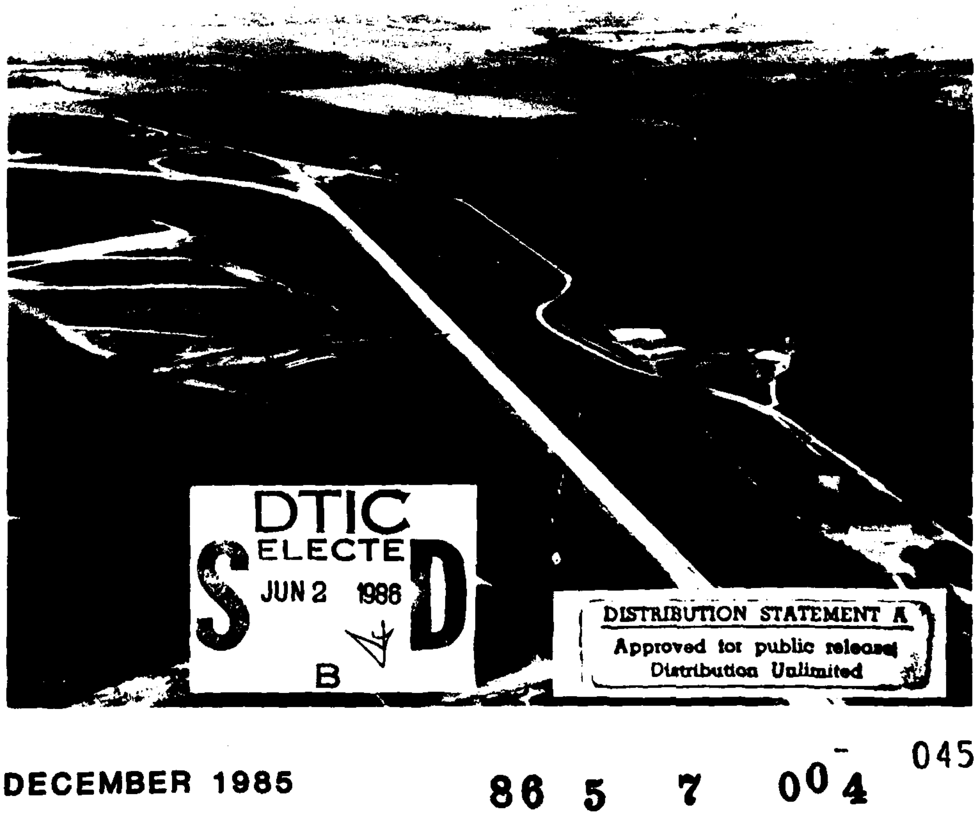
US Army Corps of Engineers
Fort Worth District

EMBANKMENT CRITERIA AND PERFORMANCE REPORT

AQUILLA LAKE
AQUILLA CREEK, TEXAS
BRAZOS RIVER BASIN



DECEMBER 1985

DEPARTMENT OF THE ARMY
FORT WORTH DISTRICT, CORPS OF ENGINEERS
P. O. BOX 17300
FORT WORTH, TEXAS 76102-0300

REPLY TO
ATTENTION OF

SWFED-F 25 April 1986

SUBJECT: Aquilla Creek, Texas, Embankment Criteria and Performance Report

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B. B. STEELE, P.E.
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AQUILLA LAKE
AQUILLA CREEK, TEXAS
BRAZOS RIVER BASIN

EMBANKMENT CRITERIA
AND
PERFORMANCE REPORT

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DECEMBER 1985

AQUILLA LAKE
AQUILLA CREEK, TEXAS

EMBANKMENT CRITERIA AND PERFORMANCE REPORT

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AQUILLA LAKE
AQUILLA CREEK, TEXAS

EMBANKMENT CRITERIA AND PERFORMANCE REPORT

SECTION 1 - INTRODUCTION

1-01. **Authority.** Authority for preparing Embankment Criteria and Performance Reports is contained in ER 1110-2-1901; Subject: Embankment Criteria and Performance Report, dated 31 December 1981.

1-02. **Purpose.** The purpose of the report is to provide the information needed to, (1) familiarize engineers with the project, (2) re-evaluate the earth embankment and ancillary structural features in the event of unsatisfactory performance and (3) provide guidance for designing comparable future projects.

1-03. **Authorization and purpose of the project.** The Aquilla Dam and Reservoir project was authorized by the Flood Control Act of 1968; approved August 13, 1968, Public Law 90-483 (82 Stat. 741) 90th Congress. The purpose of the project is flood control, municipal and industrial water supply, fish, and wildlife enhancement, and general recreation.

1-04. **Project maintenance.** The project is operated and maintained by the Corps of Engineers. Aquilla Dam is inspected annually by the Operations Division and inspected periodically by the Engineering Division in accordance with the Corps of Engineers program of "Periodic Inspection and Continuing Evaluation of Completed Civil Works Structures."

1-05. **History of project design.** Feature design for the Aquilla Lake embankment, spillway, and outlet works was presented in Design Memorandum No. 7 dated May 1976, prepared by the U.S. Army Corps of Engineers, Fort Worth District. It was reviewed by the Southwestern Division and the Office of Chief of Engineers. Prior to submittal of Design Memorandum No. 7, the overall design of the Aquilla Lake project was presented in General Design Memorandum No. 3 dated July 1975.

SECTION 2 - PROJECT DESCRIPTION

2-01. __General__. Aquilla Dam is located on Aquilla Creek in Hill County, Texas, approximately 7 miles southwest of the city of Hillsboro, Texas. The Aquilla Creek watershed is in the middle portion of the Brazos River Basin in Central Texas and has a maximum length of about 41 miles and a maximum width of about 16 miles. Aquilla Creek originates near the city of Cleburne, Texas, and flows a distance of about 54 miles in a south to southeasterly direction to its confluence with the Brazos River. Location of the project is shown on Plate 1. Major structures at the project consist of an earthfill embankment, an outlet works, and a spillway, as shown in plan view on Plate 2. Aerial photographs of the embankment, outlet works, and spillway are shown on photographic exhibits 1 and 2. The embankment is a rolled earthfill approximately 11,980 feet long. The limited service spillway consists of an uncontrolled trapezoidal broadcrested weir 1200 feet wide. The outlet works consists of an approach channel, intake structure, and service bridge; a 951 foot long cut and cover conduit, stilling basin, and discharge channel.

2-02. __Pertinent data__.

a. __Embankment__.-

(1) Type - earthfill

(2) Length - 11,980 feet

(3) Maximum height - 104 feet above streambed

(4) Crest width - 38 feet

(5) Top elevation - 582.5 feet

b. Spillway.-

(1) Type - uncontrolled trapezoidal broadcrested weir, limited service

(2) Length at crest - 1200 feet

(3) Crest elevation - 564.5

c. Outlet works.-

(1) Type - gated conduit

(2) Conduit diameter - 10 feet

(3) Conduit length - 950.5 feet

(4) Control - two 4.5 x 10-foot sluice-type gates

d. Drainage area. - 252 square miles

e. Reservoir data.-

Feature	Elevation (ft msl)	Area (acres)	Capacity*	
			Acre-feet	Equivalent runoff (inches)
Top of dam	582.5	-	-	-
Maximum design water surface	577.5	14,495	359,900	26.78
Spillway crest	564.5	8,980	213,800	15.91
Top of flood control pool	556.0	7,000	146,000	10.86
Top of conservation pool	537.5	3,280	52,400	3.90
Streambed	478.0	-	-	-

*Includes 25,700 acre-feet of storage for estimated 100-year sediment deposition, with 18,800 acre-feet below elevation 537.5 and 6,900 acre-feet between elevations 537.5 and 556.0.

SECTION 3 - CONSTRUCTION HISTORY

3-01. **General.** The embankment, outlet works, spillway, and appurtenant structures were constructed under two separate contracts. Supervision of the project construction was performed by the Corps of Engineers, Construction Division, Fort Worth District.

3-02. **Initial embankment, partial spillway excavation, and outlet works.**

a. Under the initial contract the embankment was constructed full height from station 0+00 to station 26+00. The spillway was partially excavated to provide material for the semi-compacted embankment zone, and the outlet works was completely constructed except for the service bridge. Pertinent details of the initial contract are listed below:

(1) Contract No - DACW63-78-C-0104

(2) Contractor - Clearwater Constr. Co., Inc., Austin, TX

(3) Contractor's Bid - $6,080,122.95

(4) Notice to Proceed - 5 June 1978

(5) Actual Completion Date - 20 February 1982

(6) Total Payment Including Modifications - $7,172,617.00

b. **Construction problems.**

(1) The main problems encountered on the initial contract stemmed from the earthwork contractor's inexperience in constructing

an engineered fill using high plasticity clays and in-place moisture requirements. Similar fills had been constructed on other projects with minimal difficulty, but the initial embankment earthwork contractor for the Aquilla Lake project had low fill placement rates and had to reprocess a significant amount of fill in order to produce an engineered fill within the moisture content limits required by the contract documents. The Contractor chose to adjust the moisture content in place on the embankment which proved to be a difficult task without prewetting in the borrow areas.

(2) Moderately severe problems developed during excavation for the outlet works conduit and tower foundation. The conduit and tower were both founded very close to top of rock over most of the total length of these elements. Inadequate control of groundwater and surface water, inadequate grade control, inadequate application and maintenance of shale protection (on the Contractor's part) combined with the inherently troublesome clayshale characteristics including blocky structure, extremely well developed fissility and rapid structural degradation when exposed led to widespread overexcavation and extensive hand cleanup along the outlet works. The overexcavation required a substantial volume of lean concrete backfill to reach structural concrete grade.

3-03. **Completion of embankment and spillway and construction of service bridge, access roads, project building, visitor overlook, FM 310, and other appurtenances**. Under the completion contract, the embankment was constructed in phases as shown on Plate 4. The service

bridge and project building were also completed, and the excavation of the spillway was completed. Pertinent details of the completion contract are listed below:

a. Contract No - DACW63-81-C-0035

b. Contractor - Holloway Constr. Co., and Holloway Sand and Gravel Co., Wixom, MI

c. Contractor's Bid - $11,492,320.03

d. Notice to Proceed - 4 February 1981

e. Actual Completion Date - 16 May 1983

f. Total Payment Including Modifications - $11,823,263.00

The main problems that occurred during the completion contract were related to flooding problems during embankment closure operations. In an effort to save time, the contractor opted to accomplish foundation preparation work in the Aquilla Creek channel area prior to creek diversion and construction of the upstream cofferdam. The Contractor was allowed to do this with the understanding that any flooding damage would be at his own expense. Flooding did occur and this resulted in additional cleanup and foundation preparation cost in the closure area. Also the Contractor experienced flooding problems in low lying areas which restricted his access to higher elevation borrow areas upstream. To minimize access problems the Contractor constructed a large haul road at elevation 500 which contained approximately 100,000

cubic yards of fill. This was supposed to have provided 1 year frequency flooding protection. However, during wet periods the haul road was closed due to inundation several times, thus preventing access to upstream borrow. The decision was made that the limited duration of the flooding did not justify development and reclamation costs of a downstream borrow area. Unlike the initial contract only minor problems were encountered with fill placement rates and fill moisture contents. The problem of nonuniformity in fill moisture content of the highly plastic clay was largely eliminated by prewetting in the borrow areas through the use of spray irrigation equipment.

SECTION 4 - EMBANKMENT DESCRIPTION AND CONSTRUCTION METHODS

4-01. **General.** The earthfill embankment is essentially symmetrical about its centerline and consists of a compacted central impervious core, compacted random zones adjacent to the core, and semi-compacted berms contiguous to the random zones. A select impervious zone or "cap" was designed at the crest to retard future problem with shallow sliding. Typical embankment sections are presented on Plate 3. The embankment is approximately 11,980 feet long, has a crest width of 38 feet and an approximate fill volume of 7.37 million cubic yards. The embankment height varies from an average of about 60 feet on the right abutment, about 80 feet in the floodplain, and about 40 feet on the left abutment. Maximum height above streambed is 104.5 feet.

4-02. **Embankment zoning.**

a. **Impervious core.** The central impervious core was constructed of clay material from on-site borrow. A liquid limit greater than 40 was required. The material was spread in 8-inch maximum loose lifts, processed to bring the after-compaction moisture content between optimum and optimum +3 percent, and compacted with eight passes of a sheepsfoot roller. The acceptability of in-place moisture content was determined using the liquid limit correlation method. The liquid limit correlation method is discussed in Section 8.

b. **Random zone.** The random zones were constructed of clays and clayey sands from on-site borrow. No restraints on minimum or maximum

liquid limit were used but highly pervious materials were not acceptable. The fill was spread in 8 inch maximum loose lifts, processed to bring the moisture content between -2 to +3 percentage points of optimum, and compacted with eight passes of a sheepsfoot roller. The acceptability of in-place moisture content was determined using the liquid limit correlation method.

c. Semi-compacted zone. The semi-compacted zones were constructed using materials from required excavation. For the initial contract, the main sources were the partial spillway excavation and the outlet works excavation. Semi-compacted fill material was spread in 10-inch maximum loose lifts, processed to bring the moisture content within limits of -2 to +3 percentage points of optimum, and then compacted with two passes of a 50-ton roller or four passes of a sheepsfoot roller. The liquid limit correlation method was used to evaluate the acceptability of in-place moisture content. Moisture limits for semi-compacted fill, however, were specified only for the initial contract. For the completion contract, the moisture control requirements were removed from the semi-compacted fill zones.

d. Select impervious zone. The select impervious zone or "cap" was constructed of CL materials obtained from on-site borrow with liquid limits ranging from 30 to 45. The select impervious cap was designed to minimize the potential for shallow sliding on the 1 vertical on 3 horizontal slopes. The select-impervious cap also provides an improved subgrade for the public roadway located along the crest of the dam. Fill placing, processing, and compaction requirements for select impervious fill were the same as for the random fill.

e. <u>Random rock zone</u>. A random rock zone as shown on Plate 3 was constructed at the downstream toe. The random rock zone was constructed of unprocessed limestone rock from the spillway excavation. The random rock zone contains enough rock fines to fill voids between larger rocks. The rock was placed in loose lifts varying from 12-inches to a thickness equal to the maximum size stone and compacted with four to six passes (depending on lift thickness) of a 50-ton pneumatic roller. The random rock zone was covered with 42 inches of fines from the processing of stone protection materials, and then subsequently topsoiled.

f. <u>Stone protection</u>. A 12-inch thick layer of stone protection material was placed on the upstream 1 vertical on 3 horizontal slope and a 36-inch thick layer of stone protection material was placed on the downstream 1 vertical on 4 horizontal slope as shown on Plate 3. Stone protection materials were produced from limestone from the spillway excavation. Limestone materials were passed over a vibratory bar grizzley with bars spread 4 inches apart. The materials were then passed through a rock crusher with jaws set to crush rocks greater than 12 inches. Lastly, material was passed over another vibrating bar grizzley to remove fines smaller than 2 inches.

4-03. <u>Embankment fill sources</u>. Embankment fill other than that required for the semi-compacted zone came from on-site borrow areas. Borrow areas were investigated with auger borings during the project design phase to determine the type and quantity of overburden soils present. The locations of borrow areas are shown on Plate 1. Borrow

areas were located in cleared fields and pastures. Borrow areas A, B, C, D, and E were located upstream of the embankment in the floodplain and alluvial terraces of Hackberry and Aquilla Creek. Borrow area G was located downstream from the embankment. Borrow area G was intended for use in the event that upstream borrow area became flooded or inaccessible due to flooding. During construction, borrow materials were obtained only from borrow areas A, B, and C. Borrow areas D and E and the downstream borrow area G were not utilized. Fill material for the semi-compacted zone came from required excavation. For construction of the initial embankment, semi-compacted fill material was obtained from the outlet works and partial spillway excavation. For the completion contract the source of semi-compacted fill was from the completion of the spillway excavation.

4-04. **Closure plan.** Embankment closure was made from station 46+80 to about station 54+50. Plates 4 and 5 show a view of the closure area and construction staging.

a. **Diversion channel.** Diversion was made through Aquilla Creek during construction of the embankment sections adjacent to the closure section. The creek channel was cleared to provide unobstructed flow along the natural channel alignment.

b. **Channel plugs.** Three channel plugs were constructed in the closure area as shown on Plate 5. One plug was constructed upstream from the closure section in the Aquilla Creek channel to permit diversion dike construction. The two remaining plugs were constructed

downstream from the closure area in an old and in the existing creek channel. All plugs were constructed to existing channel bank elevation. The plugs had crest widths of 20 feet, 1 vertical on 4 horizontal sideslopes and were constructed from clay. The channel was backfilled to bank elevation with semi-compacted fill materials between the embankment and the channel plugs.

c. **Diversion dike.** An upstream portion of the permanent embankment in the closure section served as a diversion dike during upstream cofferdam construction. The dike section was constructed to elevation 517.0 with a crest width of 20 feet and symmetrical 1 vertical on 4 horizontal side slopes. The dike was constructed as a semi-compacted fill using clays from borrow.

d. **Upstream cofferdam.** The upstream cofferdam was constructed as an integral part of the permanent embankment section. The upstream cofferdam, which incorporated the diversion dike, was built to elevation 537.0 with a crest width of 20 feet. The upstream slope was as given for the finished embankment and the downstream slope was 1 vertical on 4 horizontal. The cofferdam was constructed as compacted random fill and semi-compacted fill using clays from borrow. The upstream cofferdam had a projected frequency of overtopping of once every 10 years.

e. **Downstream cofferdam.** The downstream cofferdam consisted of a semi-compacted fill constructed to elevation 498 to prevent water from backing into the closure area. The cofferdam had a crest width of 20

feet, 1 vertical on 4 horizontal side slopes, and was incorporated into the downstream portion of the embankment.

4-05. Compaction equipment. The specifications governing compaction equipment for the project were based on the Civil Works Construction Guide Specification CW-02212, dated February 1976. Compaction equipment used for the job was primarily sheepsfoot rollers and rubber tired rollers. For all of the embankment zones, except the semi-compacted zone, the material that was compacted consisted mostly of overburden clays and clayey sands. For these types of material, sheepsfoot rollers provide the best results in terms of uniformity of compaction and bonding between lifts. The use of rubber tired rollers was specified as acceptable only in the semi-compacted zones. However, compaction using a sheepsfoot roller was allowed for the semi-compacted fill zone with the stipulation that the number of roller passes be doubled and that the uncompacted lift thickness be reduced from 10-inches to 8-inches. Compaction equipment used during the initial and completion embankment construction is described below:

a. Compaction equipment for initial embankment contract.

(1) Sheepsfoot roller-towed

(a) Ferguson, Model Z32

(b) Two (2) 5 ft diameter X 6 ft long drums

(c) Seven (7) rows of feet, 3 or 4 feet per row and 25 feet per drum; 9.5 in shank and tip, round shape; 9.5 sq in end area.

(d) Total weight empty - 38,457 lbs; No ballast used. Weight per foot of drum length-3,205 lbs.

(e) Oscillating frame, rigid cleaners, speed not greater than 5 mph.

(2) **Sheepsfoot roller - self propelled**

(a) Ferguson, Model 120B

(b) Two (2) 5 ft diameter X 5 ft long drums

(c) Thirty (30) rows of feet, 4 feet per row and 120 feet per drum; 10.0 in shank and tip, round shape; 9.5 sq in end area.

(d) Total weight empty - 35,900 lbs; Ballasted with fuel oil; Ballasted weight-38,370 lbs.

(e) Oscillating frame, rigid cleaners, speed not greater than 7.5 mph.

(3) **Rubber-tired roller**

(a) Ferguson, Model Rt 100-S

(b) One box, rolling width - 9 ft 2 in; length 26 ft 6 in by 9 ft 2 in.

(c) Four 18.00 X 25 tires, 24 ply

(d) Weight empty-20,000 lbs; 100,000 lbs ballasted tire pressure 90 psi, 25,000 lbs per tire

(e) Speed not greater than 5 mph

b. <u>Compaction equipment for completion contract</u>.

(1) **Sheepsfoot roller-towed**

(a) Southwest triple drum

(b) Three (3) 5 ft diameter X 6 ft long drums

(c) Seventy-two (72) rows of feet per drum; 2 feet per row, 144 feet per drum; 10 in shank and cap, round shape; 9.0 sq in end area

(d) Total weight empty - 61,000 lbs; Ballasted with water, weight-77,000 lbs; Pressure per linear foot of drum - 4,277 lbs

(e) Oscillating frame; speed not greater than 5 mph, spring loaded cleaners

(2) **Sheepsfoot roller-self propelled**

(a) Ferguson, Model SP-120-D

(b) Two (2) 5 ft diameter X 5 ft long drums

(c) Sixty (60) rows per drum, 9.5 in shank and cap, round shape, 9.5 sq in end area

(d) Total weight empty - 34,000 lbs; Ballasted with diesel fuel; ballasted weight-44,500 lbs; Pressure per lineal foot of drum-4,450 lbs

(e) Oscillating frame, speed not greater than 5 mph, spring loaded cleaners, front and rear

(3) **Rubber-tired roller**

(a) American Model 4 BW 50-ton roller

(b) One box, rolling width - 8 ft 11½ in, overall width 9 ft 5½ in, length - 25 ft 8 in.

(c) Four (4) 18.00 X 25 - 24 ply tires

(d) Weight empty - 19,500 lbs; Ballasted with sand; ballasted weight-100,000 lbs; Tire pressure - 90 psi, 25,000 lbs per tire.

SECTION 5 - GEOLOGY

5-01. **Regional Geology**.

a. **Physiography**. The project area is located in the Eastern Cross Timbers physiographic province. A small portion of the eastern and western limits of the project area extend into the Black Prairie and Grand Prairie provinces, respectively. The area topography generally reflects the eastward dipping strata of the Lower and Upper Cretaceous formations.

b. **Stratigraphy**. The project area is underlain, in ascending order, by the Georgetown, Del Rio, and Buda Formations of the Lower Cretaceous, Comanche Series, and by the Woodbine Formation and Eagle Ford Group of the Upper Cretaceous Gulf Series. The Georgetown Formation is an argillaceous limestone approximately 190 feet thick that does not crop out in the project area. The Del Rio Formation crops out in the highlands west of the project. It is a massive calcareous clay shale, ranging from 60 to 80 feet in thickness, that contains thin limestone seams. The Buda Formation, not recognized at the project site, is a thin, discontinous limestone remnant ranging from a few inches to 5 feet in thickness that unconformably overlies the Del Rio Formation. The Woodbine Formation, in turn, unconformably overlies the Buda or Del Rio Formations. The Woodbine consists of interbedded variably cemented, fine-grained sandstones and black, soft, non-calcareous clay shales that together reach a maximum thickness of 125 feet and constitutes bedrock along the entire length of Aquilla Creek.

The Eagle Ford Group unconformably overlies the Woodbine Formation and is composed of shales containing a few thin limestone beds above its contact with the Woodbine. It constitutes the bedrock of the upper eastern slopes of the Aquilla Creek valley at the dam and much of the valley of Hackberry Creek. Its maximum thickness is approximately 220 feet.

c. **Structure**. The primary structural feature is a regional dip of the bedrock of 35 to 40 feet per mile to the east-southeast, modified by the north-northeast trending Balcones fault system, which is located approximately 9 miles east of the dam. Minor faulting with small displacements have been noted in the Aquilla Creek valley near its confluence with the Brazos River.

5-02. Site geology.

a. **Physiography**. Aquilla Creek meanders across a fairly broad floodplain embraced by fairly steep valley walls. The valley wall rises abruptly for about 30 feet from the flood plain on the right abutment, then rises again in moderately steep slopes from approximately station 10+60 to the top of the abutment. At the left abutment the valley wall rises more gently and is controlled by a relatively thick, flat terrace remnant that extends for 2,400 feet eastwardly. Beyond this area, the surface rises to a low, knoll-like hill, followed by a narrow saddle, then a gently rising slope to the top of the abutment at the spillway (Plates 6 and 7).

b. Stratigraphy.

(1) **Overburden.** The right abutment is mantled by residual and slope-wash material on its upper and middle slopes and in its tributary drainages. This material consists of sandy clay from 3 to 10 feet thick that is occasionally underlain by clayey sand and sandy, clayey gravel. The floodplain is comprised of alluvial deposits that reach a maximum thickness of 37 feet. These deposits consist of an impervious lean clay blanket of an average thickness of 16 feet underlain by a clayey sand. In some areas the clayey sand is underlain by a basal gravel. A terrace remnant approximately 50 feet thick extends from stations 57+00 to 93+00. This deposit consists of silty sand, sandy clay, and clayey, sandy gravel overlain by an uppermost sandy clay that ranges from 4 to 23 feet in thickness. The left abutment is mantled on its upper slopes by approximately 2 to 8 feet of residual and slope wash material consisting principally of sandy clay.

(2) **Primary strata.** In ascending order, the Del Rio, Woodbine, and Eagle Ford Formations occur at the site and are involved in the structure foundations (Plates 6 through 10).

(a) **Del Rio Formation.** The Del Rio Formation consists of a soft to moderately hard, calcareous, gray to greenish-gray, massively bedded clay shale ranging from 70 to 80 feet thick at the damsite. Scattered thin stringers of very calcareous shale and argillaceous limestone occur through the entire section, but these generally increase in abundance downward through the lower half of the

formation. On the left abutment, where the greatest thickness is present, the Del Rio contains a few thin argillaceous limestone beds in the upper 10 feet.

(b) **Woodbine Formation.** The Woodbine Formation constitutes the primary foundation of the dam and its appurtenant structures. The Woodbine is a soft, non-calcareous, montmorillonite-type clay shale. The upper portion of the formation is characterized by a sandstone unit, while the middle and lower portions are clay shale containing a number of variably sandy shale units, some of which grade laterally into sandstone and a few thin sandstone beds. A 15-foot thick basal member of massive sandstone is present in the right abutment to station 44+00 (Plate 6). From stations 44+00 to 58+00, immediately beneath the present Aquilla Creek channel and its left bank, the Woodbine was deposited as a channel fill in the eroded surface of the Del Rio, which is now sandy shale (Plate 6). East of station 58+00, the base of the Woodbine is characterized by 1 to 3 feet of sandy shale. Overlying these basal members of the Woodbine east and west of Aquilla Creek is an 11-foot thick clay shale interval that is essentially devoid of sand or other modifying constituents. In this stratigraphic unit the shale is soft, slickensided, and has a higher void ratio than most other Woodbine clay shale sections. Above this clay shale interval the Woodbine shale contains soft sandstone seams, seams of clay-ironstone nodules and lenses, a few sandy limestone seams, and thin discontinuous sandy silt laminae and seams scattered throughout the clay shale section. The thick upper sandstone unit of

the Woodbine, which overlies the clay shale, is present only on the left abutment, and varies from 16 to 25 feet in thickness (Plate 7). The sandstone beds of the Woodbine vary widely in hardness ranging from hard to dense sand. Many of the sandstone beds are shaly. A few of the sandstone units, particularly the basal unit, contain sandy limestone which borders on very calcareous sandstone.

(c) **Eagle Ford Group.** The Eagle Ford Group is present only on the left abutment in the area of the spillway. (Plate 10) It is composed of soft calcareous shale with a few persistent, thin limestone beds and a few calcareous, sandstone streaks scattered through the section. Its contact with the underlying Woodbine is at the base of a thin limestone bed.

c. **Structure.** The primary structural feature at the damsite is the regional dip (35 to 40 feet per mile to the east-southeast) of the foundation strata. Although minor faulting was anticipated to be present at the site, no faulting was identified during exploration or construction. A significant number of fractures were noted, primarily in the 11-foot section of soft Woodbine shale. A majority of these fractures are slickensided. They appear to be a product of unloading rather than orogenic movement, and were taken into account during design and construction of the project.

d. **Groundwater, Pre-construction.** Groundwater conditions in the right abutment are essentially controlled by weathering of primary material and by the basal sandstone member of the Woodbine Formation.

These conditions cause two water tables to be present, one being a perched water table near the base of weathering, and the other being the static water table within the basal sandstone (Plate 6). This static water table exists 2 to 8 feet higher than the water table of the flood plain, whose level closely conforms with that of Aquilla Creek. No perched water table conditions exist in the left abutment. There the static water table generally conforms with the topography varying from 11 to 30 feet beneath the ground surface (Plate 7). Groundwater present in thick stream terrace deposits to the east of Aquilla Creek make it highly probable that portions of the left bank of the outlet discharge channel will suffer seepage and soft conditions through the life of the project, possibly causing maintenance problems downstream from the training walls (Plate 9).

e. **Groundwater, Post-construction.** No groundwater observation wells have as yet been installed at the project to monitor post-construction groundwater conditions.

SECTION 6 - FOUNDATION CONDITIONS

6-01. <u>General</u>. The embankment is founded on residual and alluvial overburden overlying the clay shales of the Woodbine and Del Rio Formations as shown on Plates 11 and 12. The outlet works is founded on clay shales and sandstones of the Woodbine Formation. The spillway was excavated into residual overburden and the primary strata of the Eagle Ford and Woodbine Formations.

6-02. <u>Exploration program</u>. Subsurface investigation at the Aquilla damsite occurred in several stages. The first borings made for site exploration in the general vicinity of the dam were drilled in 1940 and 1964. The first borings drilled at the actual damsite, however, were made in 1972. Four core borings and one auger boring were made along the axis of the dam. Additionally, one core boring was made near the centerline of the spillway location. Most of the 1972 borings were electrically logged for correlation and stratigraphic interpretation. The details of the 1972 borings appear in Design Memorandum No. 3, Phase I - Plan Formulation. During 1973 and 1974 additional borings were made at the damsite as follows: Four Auger borings, 26 core borings, and 1 fishtail boring were made. All the borings were like the earlier borings, "E-logged." This set of borings is detailed in Design Memorandum No. 3, Phase II - Project Design. The final stage of pre-construction field investigation occurred during 1975. The borings of 1975 are detailed in Design Memorandum No. 7, Embankment, Spillway, and Outlet Works. The 1975 borings can be broken down as

follows: 17 were auger borings, 13 were core borings, and 5 were fishtail borings. Electric logs were run in most of the borings. Additional stratigraphic data was obtained during construction from geological maps made of the inspection/cutoff trench under the axis of the dam and also from materials logged during drilling of borings for installation of piezometers and slope indicators.

6-03. Embankment foundation. The embankment foundation can be conveniently divided into four reaches consisting of **1)** the right abutment, **2)** the floodplain, **3)** the left abutment, and **4)** the extreme left abutment. The main difference in the reaches is in thickness and type of both overburden and primary strata. The primary strata, consisting of Woodbine and Del Rio clay shales, have different engineering properties. The Woodbine, varies in thickness and material type across the site. In contrast, the Del Rio which underlies the Woodbine to significant depth (average of 70 feet) has relatively uniform material properties.

a. Right abutment. The right abutment soil strata from station 0+00 to station 42+80, consist of a relatively thin veneer of overburden overlying primary clay shales (Plate 11). The strata in the reach from station 53+20 to station 60+35 are very similar to the right abutment strata and are included with the right abutment for description and design purposes. The groundwater in the right abutment foundation varied from about 21 to 54 feet below the ground surface at the time the borings were made.

(1) **Overburden.** The overburden ranges in thickness from 1 to 11 feet and varies from clayey gravel and sand to high plasticity clay.

(2) **Primary.** The primary strata immediately underlying the overburden consists predominantly of non-calcareous sandy to waxy Woodbine clay shale varying in thickness from about 33 to 75 feet. These materials are weathered to a depth varying from 5 to 41 feet below top of primary. More significantly, three persistent, slickensided zones of waxy clay shale are present at various depths throughout the right abutment foundation. A sandstone layer varying from 9 to 15 feet thick is present near the base of the Woodbine from station 0+00 to station 42+80. The Del Rio formation underlies the Woodbine and consists of intact calcareous shale with shaly limestone zones.

b. **Floodplain.** The floodplain strata (Plate 11) from about station 42+80 to station 53+20, consist of a relatively thick layer of alluvial overburden overlying primary shales. The groundwater table in the floodplain was encountered from 13 to 28 feet below the ground surface.

(1) **Overburden.** The overburden ranges from high plasticity clay and low plasticity sandy clay in the upper 15 feet to interbedded sandy clay, sandy gravel, and clayey sand below 15 feet. The overburden is from 11 to 36 feet thick.

(2) **Primary.** The Woodbine and Del Rio Formations are the primary strata of engineering importance in the floodplain. The Woodbine consists of a relatively thin wedge of unweathered, intact, sandy

clay shale with occasional sandstone and limestone layers. The Woodbine generally varies in thickness from 1 foot to 12 feet, increasing in thickness toward the left abutment. Geologic interpretation of E-log of boring 3F-31 indicates that the Woodbine may increase sharply to a thickness of about 42 feet at station 53+20 as the section approaches the left abutment. The Del Rio underlies the Woodbine, as previously described.

c. **Left abutment.** Left abutment soil strata, from about station 60+35 to station 93+20, consist of an alluvial terrace deposit overlying shales. The groundwater table varies from 19 to 39 feet below the ground surface in the left abutment.

(1) **Overburden.** The overburden soils generally range from low to high plasticity sandy clay in the upper 10 to 20 feet to interbedded, clayey sands and gravel deeper in the section. The overburden varies in thickness from 53 feet at station 72+00 to 4 feet at station 93+20.

(2) **Primary.** The primary strata immediately beneath the overburden consist of weathered to unweathered Woodbine with sandstone and limestone layers. Near the base of the Woodbine there are two waxy clay shale zones which contain scattered low-angle slickensides. Two additional, poorly defined zones of slickensided clay shale are present higher in the section from station 86+00 to station 93+20. Weathering in this reach is limited to a thin layer immediately beneath the overburden, except from about station 83+00 to station 93+20

where it extends to a maximum of about 28 feet below the top of primary.

d. **Extreme left abutment**. The soil strata on the extreme left abutment, from station 93+20 to about station 118+90, consist of a thin veneer of residual overburden overlying primary strata. The groundwater table in this reach varies from about 7 to 25 feet below the ground surface.

(1) **Overburden.** The overburden soils consist of 2 to 6 feet of low to high plasticity clays and silty and clayey sands.

(2) **Primary.** The Woodbine underlies the overburden to depths greater than 90 feet in this reach. A weathered to unweathered Woodbine sandstone layer up to 29 feet thick is present immediately beneath the overburden. The sandstone is underlain by unweathered clay shale containing sandstone and thin limestone layers.

6-04. Outlet works foundation. The outlet works structures is founded on the unweathered clay shales of the Woodbine formation (Plate 11).

a. **Intake tower foundation.** The intake tower is founded on unweathered Woodbine clay shale at about elevation 499. Two zones of waxy, slickensided clay shale are present below the base of the tower; the first, about 6 feet thick, is located about 4 feet below the tower base, and the second, about 12 feet thick, is located about 18 feet below the tower base. The remaining clay shales are intact and contain sandstone layers of varying thickness and hardness.

b. **Conduit.** The cut-and-cover conduit was founded in the Woodbine throughout its length.

c. **Stilling basin and chute.** The stilling basin and chute are founded directly on the Woodbine. The foundation for these structures is similar to that of the outlet works tower except that the waxy slickensided zones are present at a lower elevation at the stilling basin. The chute slope was cut through an upper slickensided zone and the stilling basin slab was founded on a lower slickensided zone.

d. **Approach and discharge channels.** Excavation for the approach channel cut through a maximum of about 34 feet of overburden and about 7 feet of Woodbine. Excavation for the discharge channel cut through a maximum of 19 feet of overburden materials and about 23 feet of Woodbine. Maximum depth of cut was about 41 feet for the approach and 54 feet for the discharge channel.

6-05. **Spillway excavation.** The spillway was excavated through overburden and weathered primary strata of the Eagle Ford and Woodbine formations (Plate 12). The overburden materials consisted generally of low to moderately high plasticity sandy clay and clayey sand. The primary materials consisted predominantly of moderately to highly weathered shale and sandstone.

SECTION 7 - EMBANKMENT DESIGN

7-01. <u>Design considerations</u>. Embankment sections, shown on Plate 3, were designed to safely and economically accommodate the previously described foundation reaches. Foundation conditions existing in the right abutment, floodplain, left abutment and extreme left abutment were described in Section VI.

a. <u>Design factors</u>. The following design factors were considered applicable to all embankment reaches:

(1) High excess pore pressures similar to those encountered at Waco Dam were likely to develop in the Woodbine clay shales at Aquilla Dam. These pore pressures might be transmitted undiminished along slickensides, fractures, pervious bedding planes and formational contacts as occurred at Waco Dam. Also, low shear strengths approaching residual conditions were anticipated in the Woodbine clay shale due to its slickensided nature.

(2) A select impervious cap was provided on the embankment crest and the 1 vertical on 3 horizontal slopes. This cap was designed to limit surface cracking due to drying and to prevent surface water infiltration into the upper slopes of the embankment. These properties should limit surface sloughing on the upper slopes during extended wet periods.

(3) The impervious, select impervious, and random fill materials came from borrow areas.

(4) Practically all materials from required excavation were used in the semi-compacted zones.

(5) An inspection trench was provided at the embankment centerline.

b. <u>Right abutment</u>. The right abutment embankment was designed based on the following factors:

(1) Embankment design for the right abutment was controlled by the engineering prooerties of the Woodbine clay shales. Similar material was encountered at Waco Dam wherein a foundation slide occurred through the Woodbine during embankment construction. Analysis of the Waco Dam slide indicates that the shear strength of the Woodbine clay shale can be low and considerably less than indicated by peak laboratory strengths of intact material.

(2) The right abutment section was designed to resist 80 percent excess pore pressure in the foundation assuming a factor of safety slightly greater than unity for a failure through the slickensided clay shale and assuming the mobilized shear strength was that of low but somewhat higher than residual conditions.

(3) The embankment section shown for the right abutment was also used in the reach from station 53+20 to station 58+35 due to similar foundation conditions.

c. <u>Floodplain and left abutment</u>. Floodplain and left abutment designs were controlled by the shear strength of thick overburden strata overlying the Woodbine clay shale.

d. Outlet works. The embankment slopes over the outlet works were designed to be flatter than the remainder of the left abutment embankment. This was done due to the sensitivity of the outlet works structures to movement, particularly lateral spreading under embankment load and the increased potential for such to develop due to the weak, slickensided clay shale beneath these structures. Additionally, the outlet works conduit was extended well beyond the embankment toes to accommodate flatter slopes in the event that as-designed embankment slopes above the conduit had to be flattened should spreading initiate.

e. Extreme left abutment. The embankment on the extreme left abutment was designed with relatively steep slopes. The embankment averaged about 14 feet high in this reach and was founded on a thin overburden layer overlying sandstone.

f. Embankment design and construction economy. The following design considerations resulting in construction economy were incorporated in the embankment with little or no loss in safety:

(1) Minimize the size of the impervious fill zone and thus minimize the amount of material subject to close moisture control.

(2) Minimize compactive effort in the berms by reducing the specified effort to two passes of a pneumatic roller on a 10-inch lift with the same moisture control as the random fill. On the completion contract the moisture control was totally removed from the semi-compacted fill. The only requirement was that the materials shall neither be sloppy-wet nor crusted-dry.

(3) Essentially all semi-compacted fill used in the embankment and berms was from required excavation. This eliminated any waste of required excavation materials and therefore saved the cost of borrow excavation to obtain materials for semi-compacted fill.

(4) Upstream riprap protection was not used except on the upper 1 vertical on 3 horizontal slope above elevation 574.5 where a 12 inch layer of stone protection was placed. The slope below elevation 564.5 varies from 1 vertical on 8 horizontal to 1 on 12. Experience has shown that flat slopes, particularly in cohesive material, need not be riprapped. Embankment stone protection was obtained on site by selective excavation, stockpiling and processing of limestone ledge rock from required spillway excavation rather than much more costly commercially produced riprap materials. Processing of stockpiled rock from the spillway excavation was described previously in para 4-02 f. Similarly, an erosion resistant random rock zone, consisting of unprocessed excess rock materials from required excavation, was placed in the downstream toe of the floodplain embankment to replace a riprap band required by earlier designs.

(5) Downstream inclined and horizontal drainage blankets fall in the same economy category as does riprap. Experience and theory both show that drainage blankets are not needed in clay fill embankments with long flat berms similar to Aquilla. Consequently, these were not included in the Aquilla embankment.

(6) The diversion dike and cofferdams were incorporated into the closure section, thus eliminating additional fill for these structures.

7-02. **Laboratory testing**. Laboratory testing was performed during the design stage on samples from the embankment foundation, outlet works foundation, spillway and borrow areas. The overburden materials in the floodplain area, the embankment, and the left abutment consists primarily of sandy clay and clayey sand. Shear strength tests (Q, R, and S triaxial) and consolidation tests were performed on samples from the overburden. Primary materials from the embankment area consist primarily of weathered and unweathered Woodbine clay shales and unweathered Del Rio clay shale. On the weathered and unweathered Woodbine samples Q and R triaxial and standard, residual, and presplit direct shear tests were performed. Presplit and residual tests were performed on originally intact Woodbine shales to determine a likely range of strength for slickensided materials. On the intact Del Rio shale samples, Q triaxial and standard direct shear tests were performed. From the borrow areas, seven sets of bag samples were selected for Standard AASHO compaction, Q and R triaxial compression, S direct shear, and consolidation tests. Q tests were performed on samples compacted to 100 percent of maximum Standard density at optimum moisture content and on samples compacted to 95 percent of maximum Standard density at optimum minus 3 percent, optimum, and optimum plus 3 percent. R tests were performed on samples compacted to 95 percent Standard density at optimum. S tests were performed on samples compacted to 95 and 100 percent Standard density at optimum moisture content. From the spillway excavation area two composite bag samples of weathered Eagle Ford and Woodbine shales were obtained and tested. Compaction, Q and R triaxial compression, direct shear, and controlled expansion tests were performed on the samples.

7-03. Embankment design data. Based on analysis of laboratory test results, the following strengths were adopted for embankment design:

a. Overburden. Design parameters assumed for the right abutment, floodplain, and left abutment overburden strata were as follows:

Moist Unit Weight - 127 pcf
Saturated Unit Weight - 129 pcf

Overburden Shear Strength

Type	c TSF	phi Degrees		Remarks
Q	0.7	5		All reaches except floodplain below El. 485
Q	0.4	3		Floodplain below El. 485
R	0.2	12		All reaches
S	0.0	24		Right abutment
S	0.0 0.0	24 30	(LL > 35) (LL < 35)	Left abutment and floodplain

b. Primary. The results of laboratory shear strength tests on intact specimens are not considered representative of field strengths for slickensided clay shales. Presplit and residual test results were used as a guide in estimating the shear strength of the slickensided Woodbine. Values intermediate between residual and peak were used as estimates for shear strength of the weathered Woodbine clay shale and intact unweathered Woodbine. A range of assumed shear strengths and unit weights used for the primary materials follows:

Material Type	c TSF	phi Degrees	Unit Weight - pcf Moist	Saturated
Weathered Woodbine	0	10-14	124	126
Unweathered Slickensided Woodbine	0	5-14	133	135
Unweathered Intact Woodbine	0	25	133	135
Unweathered Sandy Shale and Sandstone (Woodbine)	0	32	133	135

These strengths were used with pore pressure assumptions ranging from 0 to 100 percent in the stability analyses. Design strengths were not assigned to the Del Rio clay shales because experience and laboratory tests have shown them to be stronger than Woodbine materials; therefore, assumed failure planes were more critical in the shallower Woodbine.

c. Embankment fill.

(1) **Borrow.** The impervious zone required clays with a liquid limit greater than 40. All overburden soils except topsoil were considered acceptable for random and semi-compacted zones. The distribution of materials in the borrow areas were such that both the random and impervious zones contain similar materials. Both zones were assumed to have the following design properties:

Liquid Limit - 46

Plasticity Index - 33

Moist Unit Weight - 123 pcf

Saturated Unit Weight - 125 pcf

Type	Shear Strength c TSF	phi Degrees
Q	0.9	2
R	0.2	13
S	0.0	24

Design strengths are based on fill compacted to 95 percent Standard density at optimum plus 2 percent moisture content.

(2) **Materials from required excavation.** Materials from outlet works and spillway excavation were used in the semi-compacted zones. The excavated materials consisted mostly of weathered clay shale from the spillway but also contained overburden and unweathered Woodbine from the outlet works area. Due to lack of laboratory testing of this material, design unit weights for required excavation materials were assumed equal to 90 percent of that for compacted borrow, and design shear strengths were assumed equal to 70 percent of the strength assumed for compacted borrow. Subsequent laboratory test results during and after construction indicated that these assumptions were very conservative. There was little actual difference between the density and shear strengths of the semi-compacted, random, and impervious zones of the initial embankment. Semi-compacted fill was not tested during the completion contract.

7-04. **Stability analyses.** Stability analyses were performed during design for the right abutment, floodplain and left abutment embankment sections. The results of these analyses are summarized below:

a. Right abutment.

(1) Failure through slickensided clay shale, El. 499.

Condition	Strength	Method	Remarks	Safety Factor
End of Construction (Downstream slope)	Q,S	Wedge	80% pore pressure, phi = 10°	1.17
End of Construction (Downstream slope)	Q,S	Wedge	80% pore pressure, phi = 14°	1.34
Partial Pool (Upstream slope)	S, $\frac{R+S}{2}$	Wedge	phi = 10°	1.40
Partial Pool (Upstream slope)	S, $\frac{R+S}{2}$	Wedge	phi = 14°	1.75
Steady Seepage (Downstream slope)	S, $\frac{R+S}{2}$	Wedge	phi = 10°	1.15
Steady Seepage (Downstream slope)	S, $\frac{R+S}{2}$	Wedge	phi = 14°	1.46

(2) Failure through slickensided clay shale, El. 503.

Condition	Strength	Method	Remarks	Safety Factor
End of Construction (Downstream slope)	Q,S	Wedge	80% pore pressure, phi = 10°	1.18
End of Construction (Downstream slope)	Q,S	Wedge	80% pore pressure, phi = 14°	1.34
Partial Pool (Upstream slope)	S, $\frac{R+S}{2}$	Wedge	phi = 10°	1.33
Partial Pool (Upstream Slope)	S, $\frac{R+S}{2}$	Wedge	phi = 14°	1.69
Steady Seepage (Downstream slope)	S, $\frac{R+S}{2}$	Wedge	phi = 10°	1.12
Steady Seepage (Downstream slope)	S, $\frac{R+S}{2}$	Wedge	phi = 14°	1.44

A tabulated summary of end-of-construction condition stability analyses and manual computations for the right abutment is shown on Plate 13. Manual computations for partial pool and steady seepage conditions are shown on Plates 14 and 15, respectively.

(3) **Failure through weathered Woodbine.** Failure surfaces assumed through the weathered Woodbine have higher calculated factors of safety than those through the slightly deeper slickensided Woodbine zones.

b. **Floodplain.**

Condition	Strength	Method	Remarks	Safety Factor
End of Construction (Downstream slope)	Q	Wedge	Failure through overburden El. 473	1.47
Partial Pool (Upstream slope)	S, $\frac{R+S}{2}$	Wedge	Failure through fill at base of embankment	1.95
Steady Seepage (Downstream slope)	S, $\frac{R+S}{2}$	Wedge	Failure through fill at base of embankment	1.68

The locations of critical failure surfaces for the floodplain analyses are shown on Plate 16.

c. Left abutment.

Condition	Strength	Method	Remarks	Safety Factor
End of Construction (Downstream slope)	Q	Wedge	Failure through overburden El. 500	2.44
End of Construction (Downstream slope)	Q	Circular Arc		2.90
Partial Pool (Upstream slope)	S, $\frac{R+S}{2}$	Wedge	Failure through overburden El. 537	1.48
Partial Pool (Upstream slope)	S, $\frac{R+S}{2}$	Circular Arc		1.50
Steady Seepage (Downstream slope)	S, $\frac{R+S}{2}$	Wedge	Failure througł fill at base of embankment	1.63
Steady Seepage (Downstream slope)	S, $\frac{R+S}{2}$	Circular Arc		1.73

The locations of critical failure surfaces for the left abutment are shown on Plate 17. For all embankment sections, only downstream slopes were analyzed for end of construction condition since the upstream slopes are less critical.

d. **Extreme left abutment.** The extreme left abutment embankment section was judged by inspection to be stable and conservative. Stability analyses were not performed. This assumption is still considered appropriate. The embankment height is a maximum of 29 feet in this reach and averages about 14 feet. The foundation consists of a thin veneer of overburden overlying sandstone.

e. **Rapid drawdown condition.** The embankment is not expected to be subjected to a rapid drawdown condition because the materials com-

prising the upstream slopes are relatively impervious and the expected duration of any high pool will be brief. Therefore, saturation of the embankment is not expected to occur at a high elevation.

f. **Computations.** Computer programs supplemented with manual computations were used to perform stability analysis computations.

(1) **Wedge method with excess pore pressures.** Program SSW-039 was used to perform stability computations for the end of construction condition for the right abutment embankment. This program was used to analyze the end of construction condition using S-strengths with excess pore pressure in primary strata and Q-strengths in the embankment and overburden materials. Program execution was via Timesharing to the GE-635 computer at the Waterways Experiment Station. Computational method and accuracy were checked by hand for the right abutment end-of-construction condition (Plate 13).

(2) **Wedge method.** Program 41-R3-C102 was used to perform stability computations for the end of construction case (using Q-strengths), partial pool case (using S & $\frac{R+S}{2}$ strengths) and steady seepage case (using S & $\frac{R+S}{2}$ strengths). This program was used to analyze the floodplain and left abutment embankment sections for the three conditions cited. The program was also used to analyze the right abutment section for partial pool and steady seepage conditions. Program execution was via Cope 1200 (batch) to the GE-437 computer at Southwestern Division. Computational method and accuracy were checked by hand for the right abutment section for partial pool (Plate 14) and steady seepage (Plate 15) conditions.

(3) **Circular arc method.** Program WES-104 was used to perform stability computations for the end of construction case (using Q-strengths), the partial pool case (using S & $\frac{R+S}{2}$ strengths) and the steady seepage case. This program uses the modified swedish method of analysis.

g. **Evaluation of analyses.** In view of the foundation performance and fill conditions encountered during construction, the shear strengths and unit weights indicated by record samples, and the actual excess foundation pore pressures measured during construction, the analyses conducted during design are considered appropriate and sufficient. No additional embankment stability analyses will be conducted.

SECTION 8 - EMBANKMENT FILL CONSTRUCTION CONTROL

8-01. General. Embankment fill construction was monitored through an extensive Government quality assurance field testing program. The testing program was based on a minimum sampling frequency of one set of tests that included an in-place density per 3000 cubic yards of compacted fill. On each sample, the moisture content, liquid limit, and bar linear shrinkage were determined (Note: For the initial contract only, in-place densities were performed on each sample also). On approximately every fifth sample, a grain size analysis was conducted and the plastic limit and in-place density were determined in addition to the above tests. On approximately every tenth sample, a Standard compaction test was run in addition to the other tests. Additional testing of moisture content was performed at the discretion of the Contracting Officer as necessary to assure contract compliance. Unacceptable material, unacceptable in-place moisture content or unacceptable compaction as indicated by the tests, resulted in either reworking of the fill and retesting, or removal of the material in question. Experience on this and other embankment projects have shown for clays that if the materials, lift thickness, uniform moisture content, and compactive effort are in accordance with the specifications, then the density achieved is essentially always greater than 95 percent of maximum Standard density. These items when combined with the controls afforded by the Liquid Limit Correlation Method form a superior fill placement quality assurance program in these type materials. The data from the field tests on random, impervious, and semi-compacted

fill are tabulated on Plates 18 through 20. The average liquid limits, water contents, and percent compaction are as follows:

a. Initial contract:

	Liquid Limit	Water Content	Moisture Variation Frm Optimum,%	% Compaction
Impervious Fill	58.7	25.7	+1.7	107.1
Random Fill	52.8	23.0	+0.8	107.0
Semi-Compacted Fill	45.0	18.7	-0.4	108.2

b. Completion contract:

	Liquid Limit	Water Content	Moisture Variation Frm Optimum,%	% Compaction
Impervious Fill	64.1	26.1	+1.3	108.2
Random Fill	39.6	17.6	-0.2	107.4

During the completion contract, semi-compacted fill placement was not monitored by laboratory testing. The semi-compacted fill berm was needed only for weight in regard to embankment stability.

8-02. Liquid limit correlation method. The primary method of fill placement control was the "Liquid Limit Correlation Method". The Liquid Limit Correlation Method is based on the correlation which can be established between the liquid limits and the other engineering properties of soils. Laboratory tests on the soils used in the embankment are used to establish correlation curves which represent the relationship between the maximum dry density and liquid limit of embankment fill and also between the optimum moisture content and liquid limit of fill materials. Thus, a liquid limit value determined by

testing an embankment sample is used in conjunction with the correlation curves to determine the maximum dry density and the optimum moisture content for that sample. These values are then compared to the in-place density and in-place moisture content to determine compliance of field compaction and moisture to contract specifications or to desired minimum values.

a. **Establishment of correlation curves.** The specifications for the Aquilla embankment required that the Government laboratory conduct compaction and classification tests to be used in the establishment of correlation curves. Compaction and classification tests were performed on materials representing the entire range of materials from the borrow area and from the required excavations which were used in constructing the embankment. The specifications stipulated the minimum number of tests that would be performed on each type of materials. They included provisions for preparing the clay shale samples by three different methods for liquid limit tests as described in EM 1110-2-1906, Laboratory Soils Testing.

b. **Updated correlation curves.** Results of all quality assurance tests were furnished to the Chief, Geotechnical Branch, for plotting and continued evaluation of the accuracy of correlation curves to be used in compaction control. Separate correlation curves are sometimes set up for each type of fill material such as overburden and primary materials. However, for the Aquilla embankment construction, a good overall correlation was obtained using only one curve at a time. The correlation curve was furnished to the Resident Engineer prior to placement of fill, and it was updated periodically during construction.

c. Use of correlation curves. The relationship of field moisture content and density to specified or desired valves was determined by the Government's laboratory personnel for each embankment control sample. After determination of the liquid limit, the correlation curve of liquid limit versus optimum moisture content was used to obtain the optimum moisture content for comparison with the moisture content of the embankment control sample. For impervious fill material, the moisture content was required to be within the limits of 3 percentage points above optimum and optimum. After compaction, random, and select impervious fill moisture contents were required to be within the limits of 3 percentage points above and 2 percentage points below optimum moisture. For the initial embankment contract, the upper and lower limits of moisture content for the semi-compacted fill were the same as those specified for random material. No moisture control was specified for the semi-compacted zone of the completion embankment. Field density was compared with the estimated maximum laboratory density by using the correlation plot of liquid limit versus 100 percent Standard compaction density. Percent density was obtained by dividing the density of the control sample by the laboratory density for 100 percent Standard compaction. The target or desired minimum density was equal to or greater than 95 percent, although no minimum density was specified. As described earlier, if the specifications concerning material type, lift thickness, moisture and compactive effort are met, the percent density achieved and computed in this manner is always greater than the desired minimum for these type materials. The usual range of compacted values is from 95 percent to 120 percent compaction.

8-03. __Construction inspection by geotechnical engineers__. Foundation preparation and fill construction was also inspected and evaluated (on a continual basis) by responsible geotechnical design engineers throughout both the initial and completion contracts. All foundation approval was performed by a geotechnical engineer. Construction engineers involved were very cooperative with the design engineers in trying to achieve the intent of the design and in calling any discrepancies to the design engineers attention. This inspection and evaluation during construction by the geotechnical design engineers is routine in the Fort Worth District and is considered necessary for the construction of all massive earth and/or rock fill dams.

SECTION 9 - RECORD SAMPLES

9-01. **Record sampling program.** A total of 45 record samples were taken from the Aquilla embankment fill for testing. The record sample test data are tabulated on Plate 21. The numbers of record samples taken from each fill type on each contract are as follows:

a. **Initial embankment contract:**

Fill Type	Numbers of Record Samples
Impervous	6
Random	8
Semi-Compacted	6
Total	**20**

b. **Completion contract:**

Fill Type	Numbers of Record Samples
Impervious	9
Random	16
Total	**25**

Semi-compacted fill placed during the completion contract was not subjected to record sample testing. Stationing of the record sample locations extends from station 12+25 to station 86+00. Undisturbed and bag samples were recovered from each record sample site and subjected to the following tests:

1) Visual Classification.

2) Grain Size Analysis (Mechanical and Hydrometer).

3) Atterberg Limits.

4) Bar Linear Shrinkage.

5) Specific Gravity.

6) Consolidation.

7) Standard Compaction.

8) Direct Shear.

9) "Q" and "R" Triaxial Shear.

The tests were performed at the Southwest Division Laboratory, Dallas, Texas, with the exception of six of the record samples which were tested at the Missouri River Division Laboratory, Omaha, Nebraska.

9-02. <u>Record sample strength testing</u>. Undisturbed specimens carved from the record samples were subjected to the following strength tests:

1) Unconsolidated - Undrained ("Q" - Triaxial Shear); three or four specimens per record sample.

2) Consolidated - Undrained ("R" - Triaxial Shear); three or four specimens per record sample.

3) Consolidated - Drained ("S" - Direct Shear); three specimens per record sample.

The strength test data are summarized in plots on Plates 22 through 27. The design strength envelopes assumed during design are also

shown on the plots for comparison purposes. A tabulated comparison of the strength test results to the assumed design strength envelopes is shown in Table 9.01.

9-03. **Record sample strength testing results.** The design strength envelopes were chosen so that approximately two-thirds of the test strengths of the material tested prior to design fell above the strength envelope. It can be observed from Table 9.01 that the composite test results for the initial and completion contract indicate that 72 percent of the "R"-test strengths and 67 percent of the "S"-test strengths are above the design strength envelopes. This compares favorably with the design assumptions. It is also observed that 38 percent of the "Q"-test strengths are above the design envelope. However, since "Q"-strength governs only end of construction stability, the successful topping out of the embankment fill indicates that the "Q"-strengths were obviously adequate. This was further borne out by sensitivity studies of stability analyses which indicated that minor variations in embankment "Q"-strengths resulted in only minor variations in calculated safety factors.

TABLE 9.01

Record Sample Strength Test Result Summary.

a. Initial Contract.

TEST TYPE	FILL TYPE	NUMBER OF TESTS	% WITH STRENGTH EQUAL TO OR ABOVE DESIGN ENVELOPE
Q	Impervious	24	54
	Random	32	56
	Semi-Compacted	24	58
R	Impervious	24	92
	Random	32	87
	Semi-Compacted	22	77
S	Impervious	18	56
	Random	24	67
	Semi-Compacted	18	83

b. Completion Contract. (See Note)

TEST TYPE	FILL TYPE	NUMBER OF TESTS	% WITH STRENGTH EQUAL TO OR ABOVE DESIGN ENVELOPE
Q	Impervious	33	9
	Random	57	30
R	Impervious	33	39
	Random	48	73
S	Impervious	27	44
	Random	48	77

c. Totals - Both Contracts.

TEST TYPE	FILL TYPE	NUMBER OF TESTS	% WITH STRENGTH EQUAL TO OR ABOVE DESIGN ENVELOPE
Q	ALL	170	38
R	ALL	159	72
S	ALL	135	67

NOTE: Semi-compacted fill placed during the completion contract was not subjected to record sample testing.

SECTION 10 - INSTRUMENTATION PROGRAM

10-01. **General.** Instrumentation for the project consists of piezometers, inclinometers, settlement plates, surface reference marks, and outlet works reference marks. One hundred and six piezometers were installed to measure pore pressures. (Pore pressure in this report is defined as the ratio of increased pore pressure to increased fill load expressed as a percentage.) Eighty of these were open system and 26 were pneumatic type piezometers. Six settlement plates were installed to measure settlement of the foundation. To monitor horizontal deflection of the foundation and outlet works excavation, 16 inclinometers were installed. To monitor surface movement of the embankment fill and outlet works channel side slopes, 31 surface reference marks were installed. Movements of the outlet works conduit and stilling basin walls are monitored by a series of reference marks embedded in the concrete. As a general statement, instrumentation readings have indicated no unusual movement nor any structural distress that would adversely affect stability of the embankment or outlet works. An analysis of instrumentation readings is presented in Section 11. Instrumentation locations are shown in plan view on Plate 28 and a schedule of instrumentation is presented on Plate 29.

10-02. **Piezometers.** Piezometers for the project were installed with government forces during each of the two separate construction contracts. For the initial contract, 43 Casagrande type open system piezometers were installed: P-1 through P-38 and P-A through P-E. P-1

through P-38 were the porous plastic tube type as manufactured by Slope Indicator Company, Seattle, Washington with $^3/_8$ - inch diameter PVC risers. P-A through P-E were galvanized steel well point type piezometers. In addition to the open system piezometers, 18 pneumatic piezometers, PP-1 through PP-18, were installed during the initial contract. For the completion contract, 45 additional piezometers were installed as follows: P-38 through P-75 were the porous plastic tube type and PP-19 through PP-26 were the pneumatic type. In general, it should be noted that the open system piezometers functioned adequately while the pneumatic piezometers functional erratically and were unreliable. Typically the pneumatic piezometers recorded higher pore pressures than the open system piezometers even though both types monitored the same strata. The main reason that pneumatics were selected for use on the project was to minimize potential problems with time lag in pore pressure response in the low permeability clay shale. In actuality even in the open system piezometers time lag proved to be an insignificant problem. Most of the problems encountered with the pneumatic piezometers was due to their complexity. A typical installation schematic is shown on Plate 28. The pneumatics used for the Aquilla project were manufactured by Slope Indicator Company, Seattle Washington. The transducers utilize a flexible diaphram and a ball check valve. To take a reading, the force of the diaphram due to water pressure is equalized by gas pressure applied through the input tube. When the gas and water pressure are equalized the ball valve closes and the gas pressure, which registers on a gage, is equal to the pore pressure. One of the disadvantages of this type

of instrument is that the displacement of the check valve that occurs at the instant of reading will artifically increase the pore pressure. This problem is not severe in high permeability soils where increased pressures can quickly bleed off, but in low permeability material such as clay shale, measured pressure will be too high. Other problems experienced with the pneumatic piezometers were gas flow rate problems when long tubes were used and sticking check valves.

10-03. Inclinometers. Sixteen inclinometers were installed at the project. Inclinometers I-1 through I-12 were installed during the initial contract and I-13 through I-16 were installed during the completion contract. The inclinometers were constructed of 3.34-inch diameter grooved PVC casing, the type manufactured by Slope Indicator Company.

10-04. Settlement plates. Six settlement plates were installed at the project. Settlement Plates SP-1 through SP-4 were installed during the initial contract and settlement Plates SP-5 and SP-6 were installed during the completion contract. All the settlement plates consist of 3-foot square, 1/4-inch thick steel plates placed on the embankment foundation with steel riser pipes extended through the fill.

10-05. Surface reference marks. During the initial contract, 31 surface reference marks were installed. No surface reference marks were installed during the completion contract. The surface reference marks consist of sections of 6-inch diameter steel pipe filled with concrete with brass survey monuments installed in the tops.

10-06. __Outlet Works Reference Marks.__ Reference marks were installed along the invert of the conduit, on the intake tower, along the discharge chute, and on the stilling basin walls. The reference marks consist of bronze bolts embedded in concrete.

SECTION 11 - INSTRUMENTATION ANALYSIS

11-01. Piezometers.

a. General. Foundation piezometers were installed for the initial embankment of Aquilla Dam in two general locations, line A and line B. Line A is near the right abutment and extends from station 17+00 to station 21+00. Line B is near the end slope of the initial embankment and extends from station 24+70 to station 26+50. Foundation piezometers were also installed during the completion contract in four lines, designated line C through line F. Instrumentation line C is located at station 41± on the right abutment of the Aquilla Creek floodplain. Line D is located at station 47± on the west side of Aquilla Creek and line E is located at station 53± on the east side of Aquilla Creek. Line F is located at station 70± on the east side of the outlet works. A plan view of the instrumentation location is shown on Plate 28.

b. Instrumentation line A. Piezometers for instrumentation line A were installed in three cross-sections, A, A_1, and A_2 as shown on Plates 30 through 33. Piezometers for line A were installed in several different foundation strata in both the Woodbine and the Del Rio formations. However, most of the piezometers for line A were installed in the "waxy" clay shale units of the Woodbine formation. These clay shale units were expected to develop the highest pore pressure during construction. At the right abutment there are two waxy units separated by a thick sandstone unit. Also, numerous piezometers were

installed at the contact between the Woodbine and Del Rio formations and one piezometer was installed deeper in the Del Rio. Thirty-seven piezometers were installed along line A, but 20 were subsequently abandoned and are no longer being read. A number of the piezometers were damaged by the Contractor's operations and the remainder were abandoned because of erratic, meaningless readings. However, sufficient piezometers were operational to provide adequate data on pore pressure development in the foundation. Plot of piezometric and fill elevation versus time are shown on Plate 43 through 56 for all functional piezometers.

c. **Analysis of piezometric readings for line A.** Based on the Waco Dam experience, it was expected that the highest pore pressures would develop in the "waxy" Woodbine clay shale (which is the same geologic unit as the Pepper Shale in the foundation at Waco Dam) or at the Woodbine-Del Rio contact. However, along line A the highest pore pressure development as recorded by open system piezometers, occurred deeper in the Del Rio formation rather than in the "waxy" Woodbine or at the Woodbine-Del Rio contact. Even though the Del Rio formation is lower in elevation, the piezometric elevations in the Del Rio piezometers were almost as high as the elevations recorded in the "waxy" Woodbine units. This behavior occurred despite the fact that the Del Rio clay shale is much stronger than the clay shales of the Woodbine formation and is partially cemented with calcium carbonate where the Woodbine clay shales are non-calcareous. Apparently, the "waxy" units of the Woodbine have significant fracture permeability compared to the

permeability of the Del Rio formation. Pore pressure that developed were able to bleed into a sandstone layer that underlies the "waxy" Woodbine. Water level in the sandstone layer remained the same as static groundwater conditions through out the embankment construction period. The time lag exhibited by piezometer P-12, with its tip in the Del Rio shale reinforces this reasoning that the Del Rio clay shale is much more impervious than the "waxy" Woodbine. To date, the piezometric level of this piezometer has stopped increasing but has not decreased. The highest pore pressure response recorded in P-12 was 72 percent. In the Woodbine P-A and PP-8 showed the highest pore pressures, 64 percent and 76 percent, respectively. Along line A the piezometer readings indicate no lateral transmission of high pore pressures from the centerline toward either the upstream or downstream toes. This was a significant observation since it was lateral transmission of excess pore pressure toward the downstream toe that contributed to the Waco Dam slide. Piezometer data for line A are detailed on Plate 41.

d. <u>Instrumentation line B</u>. Piezometers for instrumentation line B were installed two cross-section, B and B_1, as shown on Plates 34 through 37. Foundation strata at line B are similar to line A and piezometers were installed in the same basic geologic units that were monitored at line A. Most of the piezometers were installed in the "waxy" clay shale units of the Woodbine formation and at the Woodbine-Del Rio contact. Of the 24 piezometers installed along line B, 15 are inoperative and have been abandoned. Plots of piezometric and fill

elevation versus time for the functional piezometers are presented on Plates 43 through 56.

e. <u>Analysis of piezometer readings for line B</u>. Pore pressure response as a result of fill placement along line B was greatest in the Del Rio formation and was similar to Del Rio pore pressure response for line A. The highest piezometric elevation was 560 feet measured in Del Rio piezometer P-28 (Plate 46). Pore pressure response for piezometers in the "waxy" Woodbine formation along line B was less than expected. The highest piezometric elevation was 534 feet measured in the "waxy" Woodbine piezometer P-26 (Plate 46). Piezometric levels at the Woodbine-Del Rio contact were about the same at line B as in line A. Based on the piezometer readings, there is no evidence of any transmission of high pore pressures toward the embankment toes. Most piezometers at or near the toes demonstrated very little pore pressure response due to fill placement and essentially monitored the groundwater level. It is interesting to note that the percent pressure development in the "waxy" Woodbine strata along line B was less than along line A. The primary factor contributing to this difference was the smaller height of fill at line B. The fractured, jointed Woodbine shale along instrumentation lines A and B has significant fracture permeability which may be the reason that pore pressure development was not high. As fill loading increases, the fracture permeability is reduced thus allowing for the development of higher excess pore pressure. Since line B had a smaller fill height, the fracture permeability was less diminished, and pore pressure response was not as great.

f. Instrumentation of line C. Piezometers for instrumentation line C are shown in profile on Plate 38. Both the open system and pneumatic piezometers were installed in a "waxy" Woodbine clay shale unit just above a thick sandstone unit. Plots of piezometric and fill elevation versus time are shown on Plates 43 through 56.

g. Analysis of piezometer readings for line C. Pore pressure response along line C has been low. The maximum piezometric elevation recorded during construction was 532 feet which was measured in piezometers P-42 (Plate 38). Most piezometers essentially monitored the groundwater table or were dry. The lack of pore pressure response along line C is attributed to the presence of fracturing in the Woodbine shale adjacent to the floodplain. The shale at line C comprises the right abutment of the floodplain and has geologically undergone more stress relief both vertically and laterally than the shale under the initial embankment; and, as a result, the shale has greater mass permeability. A perched water table does not exist at line C. Several of the piezometers were installed in unsaturated strata above the permanent water table. Of all the piezometers installed along line C, only open system piezometer P-42 recorded any significant buildup of pore pressure. Piezometer P-42 measured a maximum pore pressure response of 65 percent.

h. Instrumentation line D. Piezometers for instrumentation line D were installed in several different strata as shown on Plate 39. Most of the piezometers were installed at the contact of the Woodbine and Del Rio formations or in a "waxy" unit of the Woodbine just above

the contact. The thick sandstone unit that exists at line C has apparantly been removed by erosion and is not present at line D. Also at line D, piezometers were installed in the overburden strata and in the clay shale of the Del Rio formation. Plots of piezometric elevation and fill elevation versus time are shown on Plate 43 through 56.

i. <u>Analysis of piezometer readings for line D</u>. The maximum piezometric elevations recorded during construction for the strata that were monitored and the corresponding percent pore pressure responses are shown on Plate 42. The highest pore pressure response at line D occurred in the Del Rio. Piezometers in the overburden strata developed essentially no excess pore pressure and essentially monitored the groundwater table. The piezometers at the Woodbine-Del Rio contact and those located above the contact in the Woodbine clay shale developed only moderate pore pressures. The percent pore pressure development for the piezometers installed along line D in the Woodbine clay shale was much less than pressures developed along line A. The primary reason for this behavior is that the Woodbine clay shale encountered during the completion contract along instrumentation lines D and E is very sandy and is borderline sandstone. As a result, it has more rigid structure and is much more pervious than the Woodbine clay shale unit monitored for the initial contract. Also, it should be noted from Plate 42 that P-51 which is located at the Woodbine-Del Rio contact indicated less pore pressure development than adjacent piezometers also located at the contact. This is probably a result of pore pressures bleeding off into the overlying overburden strata. Of

the different strata monitored at line D, the greatest pore pressure response occurred in the Del Rio clay shale. A series of piezometers, P-52, P-73, P-74, and P-75 were installed just above the Del Rio correlation bed as shown on Plate 42. All four of the Del Rio piezometers exhibited piezometric levels higher than the embankment fill. The percent pore pressure response for the Del Rio piezometers along line D was similar to that recorded along lines A and B. This was expected since the Del Rio shale at both locations had similar characteristics. It was massive, calcareous, and had high strength compared to Woodbine clay shale which has relatively low strength, and is highly fractured, jointed, and non-calcareous.

j. Instrumentation line E. Piezometers for instrumentation line E were installed in two strata as shown on Plate 40. The upper stratum being monitored was the "waxy" clay shale unit of the Woodbine formation. The lower stratum monitored was at the Del Rio correlation bed. No thick sandstone unit was encountered along this line. Plots of piezometric elevation and fill elevation versus time are shown on Plates 43 through 56.

k. Analysis of piezometer reading line E. For instrumentation line E, all piezometers were installed in Woodbine clay shale except for P-65 which was installed in Del Rio clay shale. Readings in the Woodbine clay shale were all quite low or simply reflected groundwater fluctuations, except for P-67, which registered a maximum piezometric level above the top of fill. This response is due to the characteristics of the Woodbine in this area. The Woodbine shale along line E

abuts the floodplain. The shale in this zone has undergone stress relief due to unloading from erosion. This has produced a fractured and jointed structure in the shale which has increased permeability. Also, the shale along line E is interbedded with numerous sandstone layers. At piezometer P-67, the Woodbine strata is thicker and the piezometer tip was possibly located in a more intact zone with less fracturing. In the Del Rio formation, piezometer P-65, unlike the Del Rio piezometers at line D, exhibited only a moderate pore pressure response. It may be that the tip was not installed deep enough into the Del Rio and pressure may have partially bled off into the more pervious Woodbine formation.

11-02. **Inclinometers.**

a. **General description.** During the initial contract, 12 inclinometers were installed, I-1 through I-5 along instrumentation line A, I-6 through I-10 along instrumentation line B, and I-11 and I-12 at the outlet works discharge channel. The inclinometers for the initial contract are shown in plan view on Plate 28. They were bottomed approximately 15 feet into the clay shale of the Del Rio formation. Inclinometers I-1 through I-10 were designed to monitor horizontal movements of the embankment foundation. The instruments were cased through the embankment fill with steel pipes. Inclinometers I-11 and I-12 were designed to monitor channel slope movements during the excavation of the outlet works channel. During the completion contract, four inclinometers, I-13 through I-16, were installed in the embankment closure section at locations shown on Plate 28. These inclino-

meters were designed to monitor horizontal movement of embankment foundation. All embankment foundation monitoring inclinometers were bottomed a minimum of 15 feet into the Del Rio formation.

b. **Analysis of inclinometer data.** Inclinometers were used to measure horizontal movement in the foundation only. No readings were taken in the embankment fill since foundation shear strength and not fill shear strength controlled the embankment design. Inclinometer readings have indicated only minor horizontal movement in the foundation. Most of this movement has occurred in the overburden and weathered primary strata. Essentially no movement occurred below the weathered zone. Plots of horizontal deflection versus depth are shown on Plates 57 through 61. There is an expected amount of scatter in the data, due to the variations in the different monitoring equipment, probes, cables, and readers used to obtain the readings. However, even with the scatter, the general trend is upstream deflection for the upstream inclinometers and downstream deflection for the downstream inclinometers. It should also be noted that the greatest horizontal movement occurred near the centerline where embankment settlement is greatest. No significant deflection was observed in the unweathered primary including the "waxy" clay shale units.

11-03. Foundation settlement plates and surface reference marks. For the initial contract, foundation settlement Plates, SP-1 through SP-4, and surface reference marks, RM-1 through RM-31, were installed at locations shown on Plate 29. During the course of the initial contract, the bench marks used to obtain surveyed settlement plate eleva-

tions were found to be unstable, probably due to ground surface movement caused by soil moisture changes. As a result, the settlement plate elevation readings were erratic. To remedy this problem, "free standing" deep bench marks were installed. These deep bench marks were designed to be independent of shallow ground movements due to moisture changes. The deep bench marks installed in the summer of 1980 were intended to be the basis of the settlement plate and surface reference marks surveys. However, when the deep bench marks were tied together by survey, the error of closure in the traverse was excessive. It was determined that the PVC casing used to construct the deep bench marks was curved and allowed the free standing steel pipe to rub against the casing. Due to the continued lack of a reliable bench mark, the settlement plate and surface reference mark readings were discontinued on the initial contract. For the completion contract "core tipped" deep bench marks were successfully used to provide a stable bench mark for the settlement plate measurements. This type bench mark is constructed of a 3-inch diameter machined steel cone welded on to a 0.5 inch diameter steel rod. After a bore hole is drilled the cone and attached rod is pushed into the stable founding strata. A protective 2-inch diameter steel pipe is installed over the 0.5 inch diameter steel rod. The hole is then filled with grease except for the top portion which is grouted. For the completion contract, two settlement plates, SP-5 and SP-6, were installed to monitor foundation settlement of the overburden and weathered primary. Both settlement plates were installed on line D, SP-5 was located 90 feet upstream and SP-6 was located 90 feet downstream. Plots of plate ele-

vation and fill elevation versus time are shown on Plate 62. Only moderate settlements were indicated from both instruments.

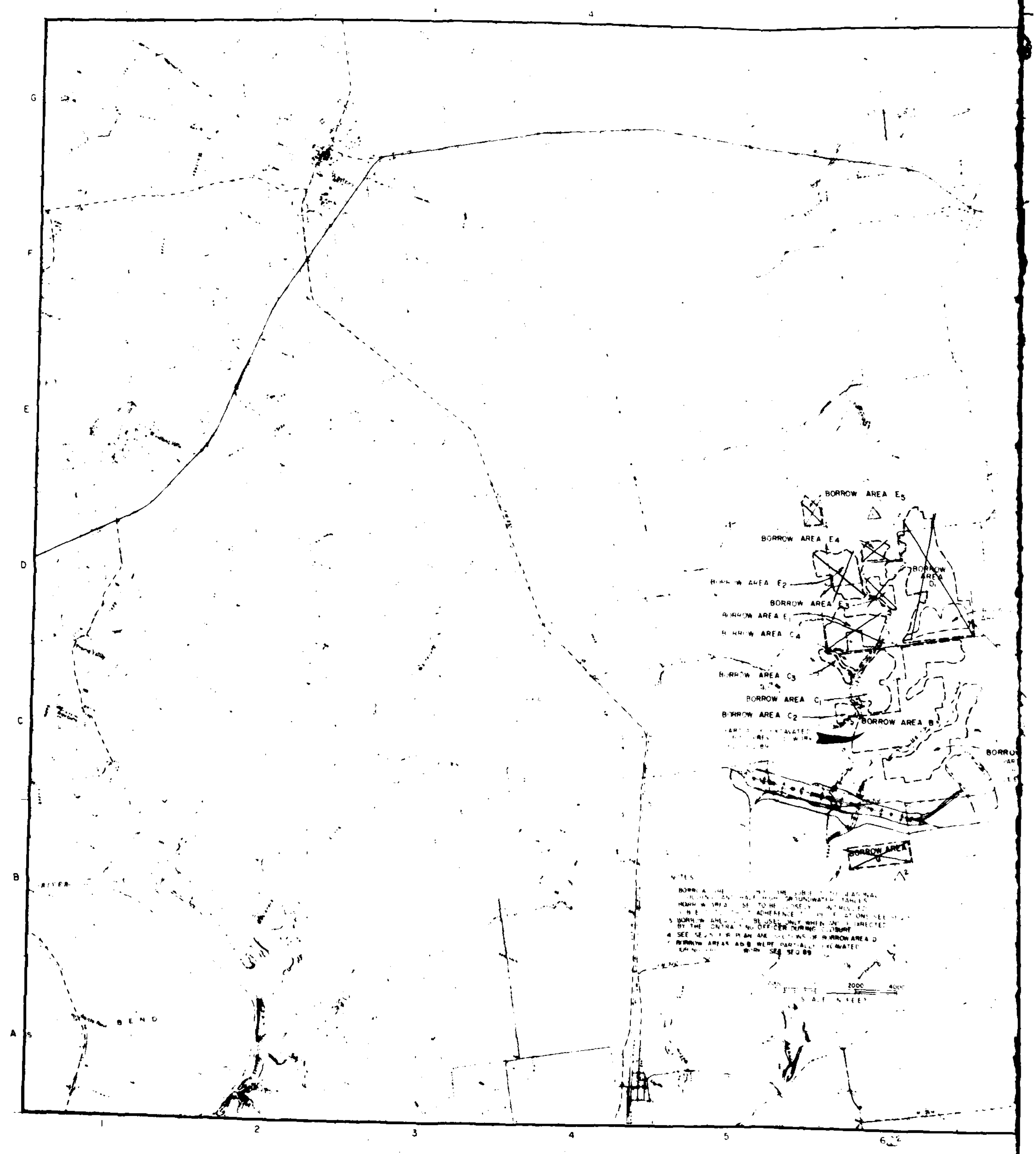
11-04. Outlet works reference marks. Reference marks were installed along the invert of the conduit, on the intake tower, along the discharge chute, and on the stilling basin walls. The reference marks were surveyed after installation in January 1981. A subsequent set of readings was taken in October 1981. Diversion of water througn the outlet works during construction was necessarily caused by the inability to close the gates. Electric power required to operated the gates had not been connected. Therefore, no readings were taken until May 1983. Electric power was connected to the control tower in March 1983 making the gates operable. Two additional sets of outlet works reference mark readings were made in May 1983 and March 1984. Plot of the reference mark readings for the outlet works are shown on Plate 63. The initial set of readings taken in January 1981 shows that the outlet works conduit was constructed approximately 0.2 foot higher than the elevation shown on the contract plans. The second set of readings made in October 1981 indicated that only minor vertical movements took place as a result of embankment fill placement over the conduit during the period from January 1981 to October 1981. Readings taken on 12 May 83 indicate end of construction settlement. The maximum settlement recorded was approximately 0.1 foot at the embankment centerline. Readings made in March 1984 indicated no additional displacement and were not plotted. No significant spreading or misalignment of the monolith joints has occurred.

SECTION 12 - INSERVICE EVALUATION

12-01. **General.** The inservice performance of the Aquilla Lake embankment and appurtenant structures' foundations has shown to be excellent. Deliberate impoundment began on 29 April 1983. The impounded pool had reached elevation 532.4, or about 5 feet below conservation pool, as of January 1985. Surveillance inspections have been conducted subsequent to construction in accordance with the "Reservoir Filling Plan", DM No. 23. No signs of structural distress have been observed.

12-02. **Embankment stability.** In view of the foundation performance and fill conditions encountered during construction, the shear strengths and unit weights indicated by record samples, and the actual excess pore pressures developed during construction, the analyses conducted during design are considered appropriate and sufficient. No additional embankment stability analyses will be conducted.

12-03. **Dam safety.** The Fort Worth District has a strong commitment to dam safety. The Aquilla dam embankment has already been subjected to two inspections by teams of geotechnical engineers and geologists as part of the program for Continued Evaluation of Completed Civil Works Projects. Instrumentation is being read and interpreted on a scheduled basis. All data and observations during and subsequent to construction indicate the embankment is and will continue to function as a safe structure as designed.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BORROW AREA E_2
BORROW AREA D
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BORROW AREA C_3
BORROW AREA C_1
BORROW AREA C_2
BORROW AREA B
BORROW AREA
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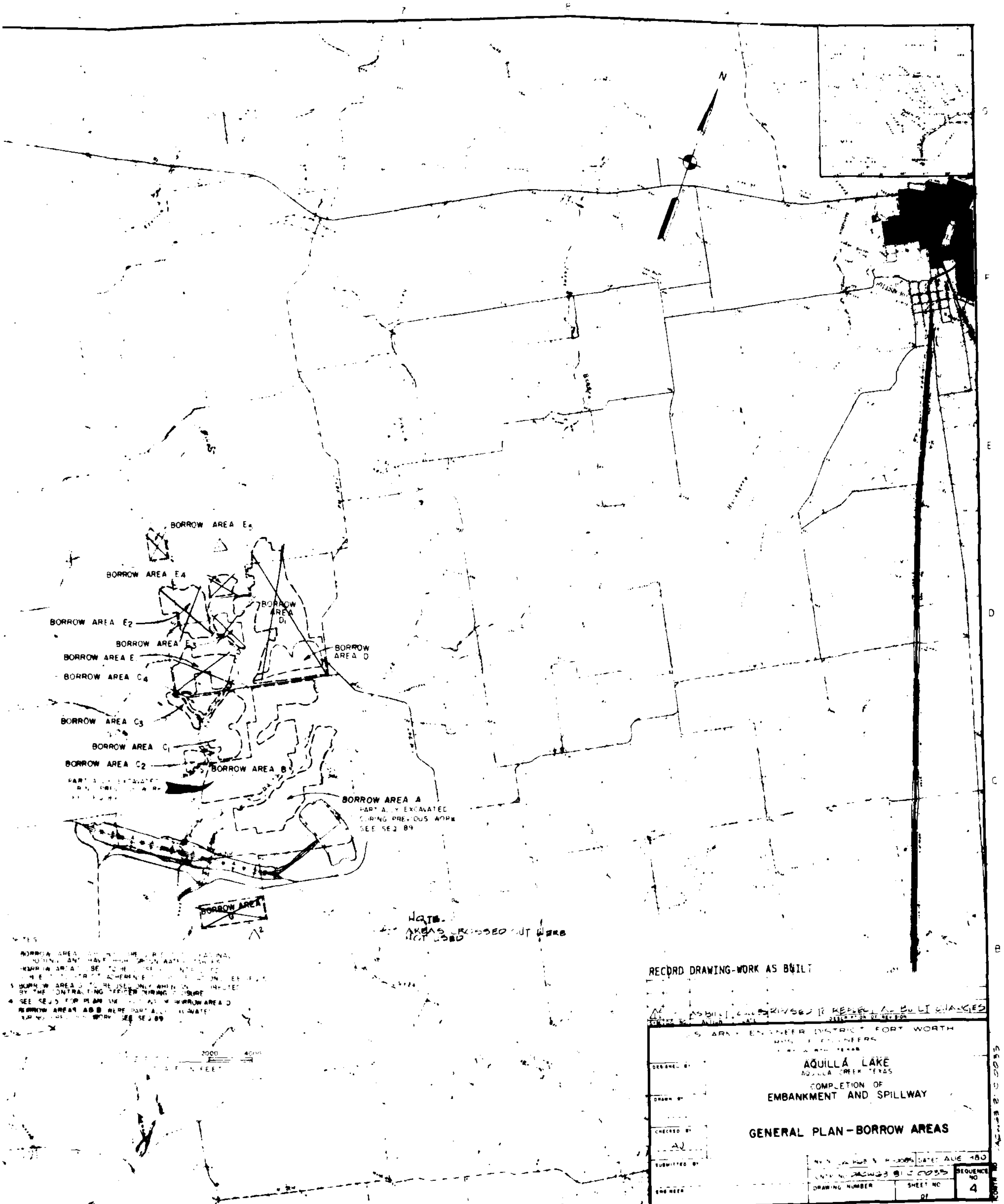
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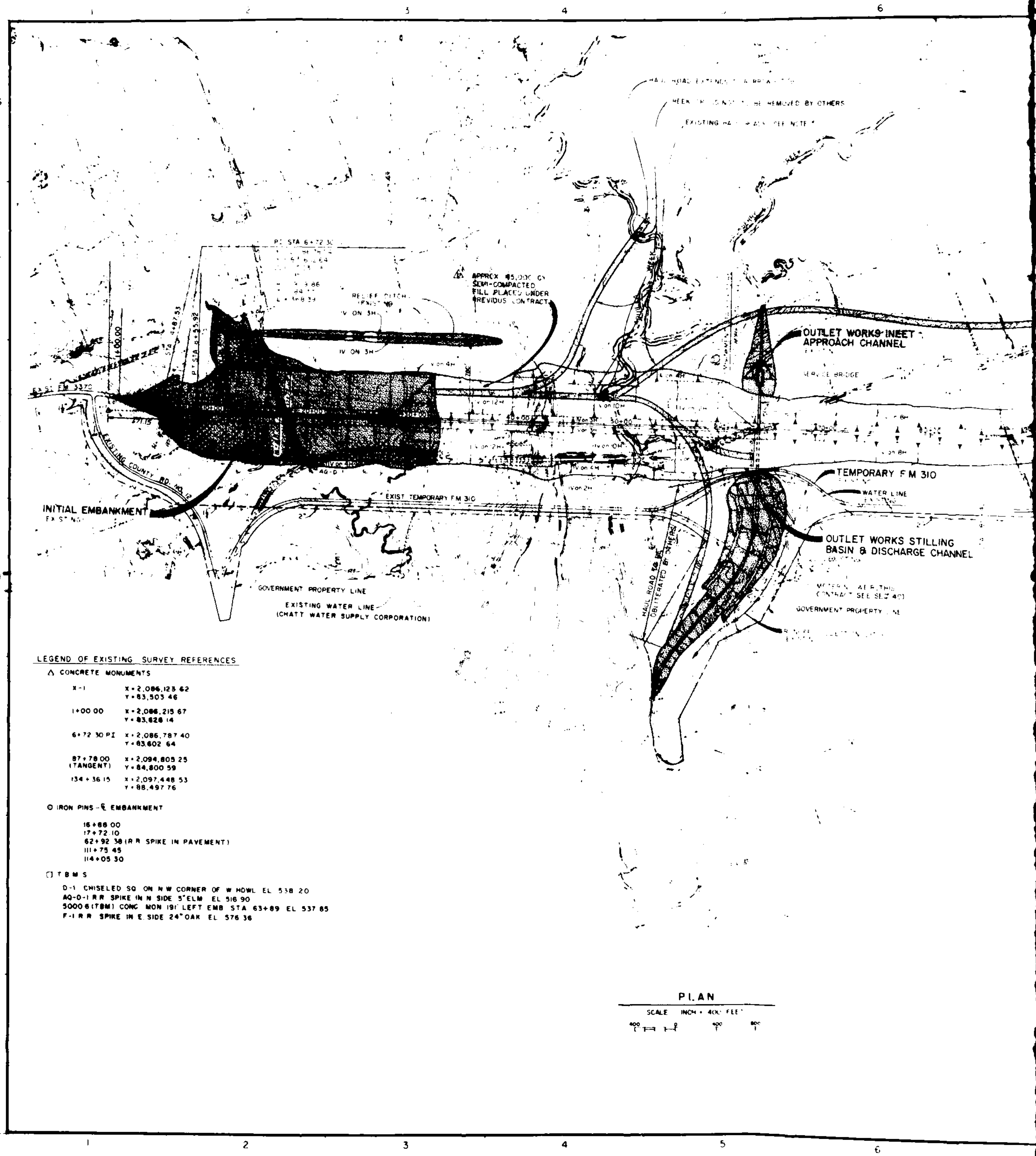
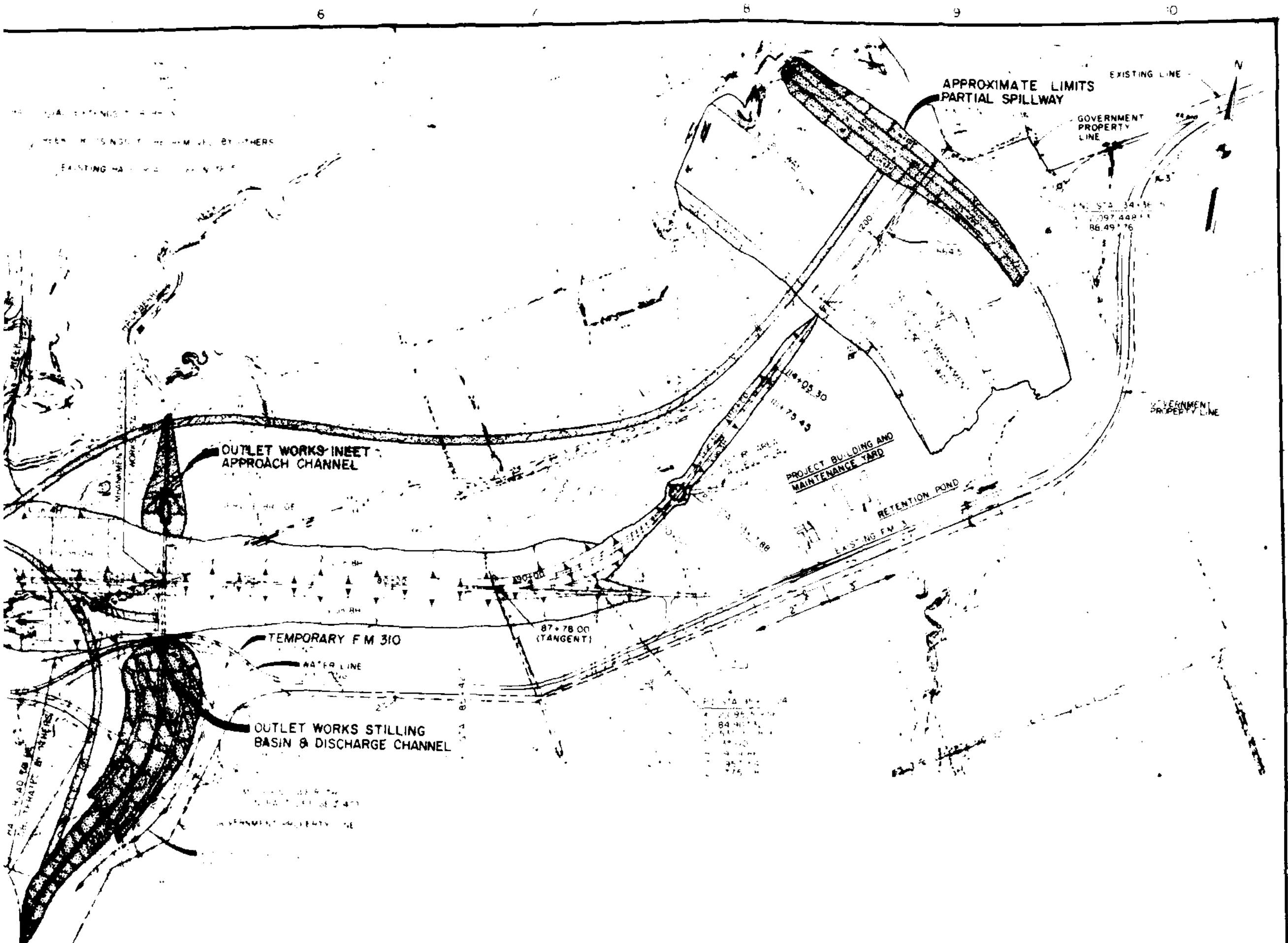
BORROW AREA D
BORROW AREA C_3
BORROW AREA C_1
BORROW AREA C_2
BORROW AREA B
BORROW AREA A
PARTIALLY EXCAVATED
DURING PREVIOUS WORK
SEE SEQ 89
BORROW AREA
NOTE:
AREAS CROSSED OUT WERE NOT USED
RECORD DRAWING-WORK AS BUILT
U.S. ARMY ENGINEER DISTRICT FORT WORTH
AQUILLA LAKE
AQUILLA CREEK TEXAS
COMPLETION OF
EMBANKMENT AND SPILLWAY
GENERAL PLAN-BORROW AREAS
CHECKED BY
AJ
DATE AUG 480
DRAWING NUMBER
SHEET NO
SEQUENCE NO
4

PLATE 1


OUTLET WORKS INLET APPROACH CHANNEL
SERVICE BRIDGE
APPROX 85,000 CY SEMI-COMPACTED FILL PLACED UNDER PREVIOUS CONTRACT
RELIEF DITCH (EXISTING)
PI STA 6+72.30
1V ON 3H
EXIST FM 3370
EXISTING COUNTY RD. NO. 12
INITIAL EMBANKMENT
EXISTING
EXIST TEMPORARY FM 310
TEMPORARY FM 310
WATER LINE
OUTLET WORKS STILLING BASIN & DISCHARGE CHANNEL
GOVERNMENT PROPERTY LINE
EXISTING WATER LINE (CHATT WATER SUPPLY CORPORATION)
HAUL ROAD TO BE OBLITERATED BY OTHERS
LEGEND OF EXISTING SURVEY REFERENCES
△ CONCRETE MONUMENTS
X-1 X=2,086,123 62 Y=83,503 46
1+00 00 X=2,086,215 67 Y=83,628 14
6+72 30 PI X=2,086,787 40 Y=83,602 64
87+78 00 (TANGENT) X=2,094,805 25 Y=84,800 59
134+36 15 X=2,097,448 53 Y=88,497 76
○ IRON PINS - ℄ EMBANKMENT
16+88 00
17+72 10
62+92 38 (R R SPIKE IN PAVEMENT)
111+75 45
114+05 30
□ T B M S
D-1 CHISELED SQ ON N W CORNER OF W HDWL EL 538 20
AQ-O-1 R R SPIKE IN N SIDE 5" ELM EL 516 90
5000 6 (TBM) CONC MON 191' LEFT EMB STA 63+89 EL 537 85
F-1 R R SPIKE IN E SIDE 24" OAK EL 576 36
PLAN
SCALE 1 INCH = 400 FEET



PLAN

SCALE 1 INCH = 400 FEET

NOTES

1. SEE SEQUENCE NO. 21 FOR TURFING TREATMENT FOR AREAS DISTURBED BY THE CONTRACTORS OPERATIONS
2. THE CONTRACTOR'S CAMPS, STORAGE, HOUSING FACILITIES, OR OTHER CONSTRUCTION BUILDINGS AND YARDS SHALL BE LOCATED BY THE PROJECT ENGR. AND APPROVED BY THE CONTRACTING OFFICER
3. CLEARING AND GRUBBING TO BE 30' BEYOND THE LIMITS OF THE EMBANKMENT FILL UPSTREAM AND 20' DOWNSTREAM OF TOE DITCHES
4. CLEARING AND GRUBBING TO BE 30' BEYOND LIMITS OF SPILLWAY EXCAVATION
5. THE CONDITIONS OF THE HAUL ROADS AND THEIR EXCLUSIVE USE BY THE CONTRACTOR CANNOT BE ASSURED
6. APPROXIMATELY 45,000 C.Y. OF SEMI-COMPACTED FILL MATERIAL WAS PLACED IN THE UPSTREAM SEMI-COMPACTED ZONE FROM STATION 32+00 TO STATION 34+00 UNDER THE PREVIOUS CONTRACT

RECORD DRAWING-WORK AS BUILT

SYMBOL NO.	ACTION	DATE	DESCRIPTION OF REVISION
5	[illegible]	[illegible]	REVISED TO REFLECT [illegible] CHANGES

U S ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

AQUILLA LAKE
AQUILLA CREEK, TEXAS

COMPLETION OF
EMBANKMENT AND SPILLWAY
AND CONSTRUCTION OF
SERVICE BRIDGE, ACCESS ROADS, PROJECT BUILDING, VISITORS OVERLOOK, F M 310 AND OTHER APPURTEANCES

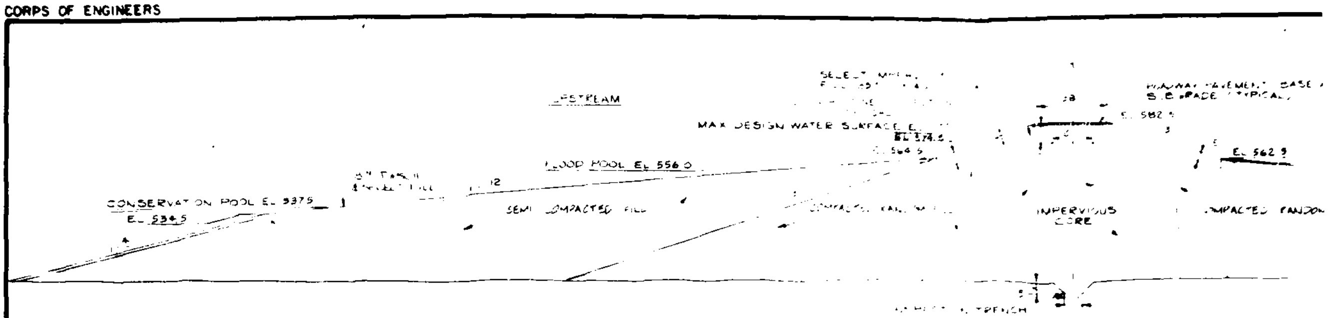
GENERAL PLAN

DESIGNED BY: F.E.C.
DRAWN BY:
CHECKED BY: AFJ
SUBMITTED BY:
ENGINEER:

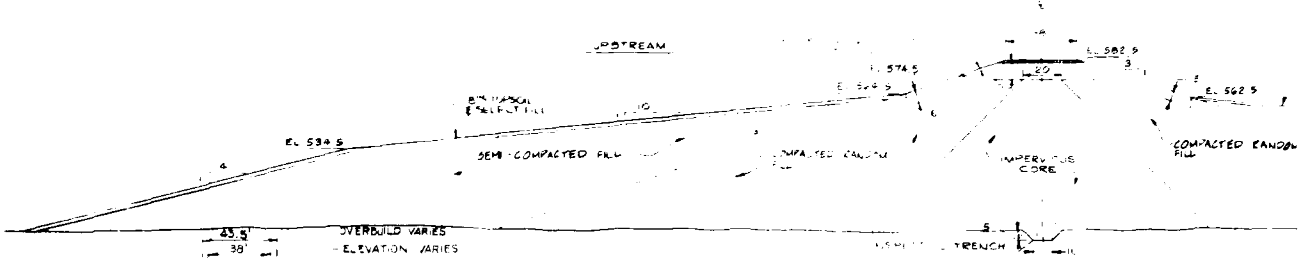
INV. NO. [illegible] 2086 DATED AUG 1980
CONTR NO. [illegible] 35
DRAWING NUMBER
SHEET NO. 2
SEQUENCE NO. 3

PLATE 2

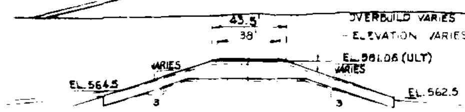
CORPS OF ENGINEERS



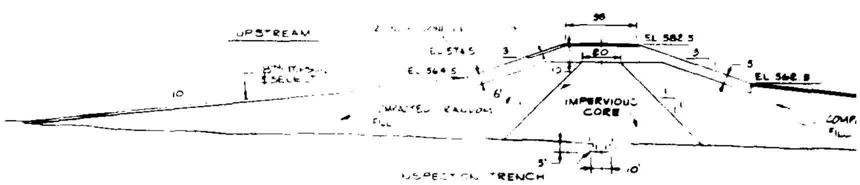
TYPICAL EMBANKMENT SECTION - I
STATION 0+00 TO STATION 26+00
STATION 26+00 TO STATION 42+80
STATION 53+20 TO STATION 58+35



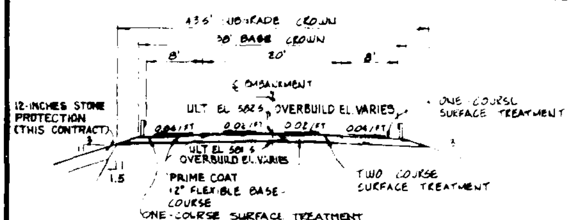
TYPICAL EMBANKMENT SECTION - II
STATION 44+80 TO STATION 51+20



TYPICAL EMBANKMENT OVERBUILD SECTION
N.T.S

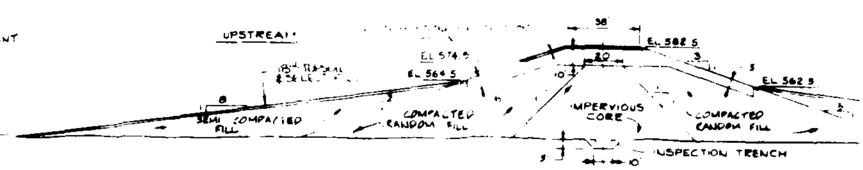


TYPICAL EMBANKMENT SECTION - III
STATION 60+35 TO STATION 64+35



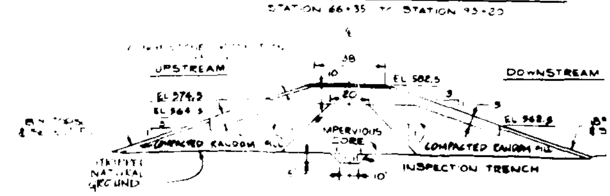
TYPICAL EMBANKMENT CROWN DETAIL

SCALE IN FEET

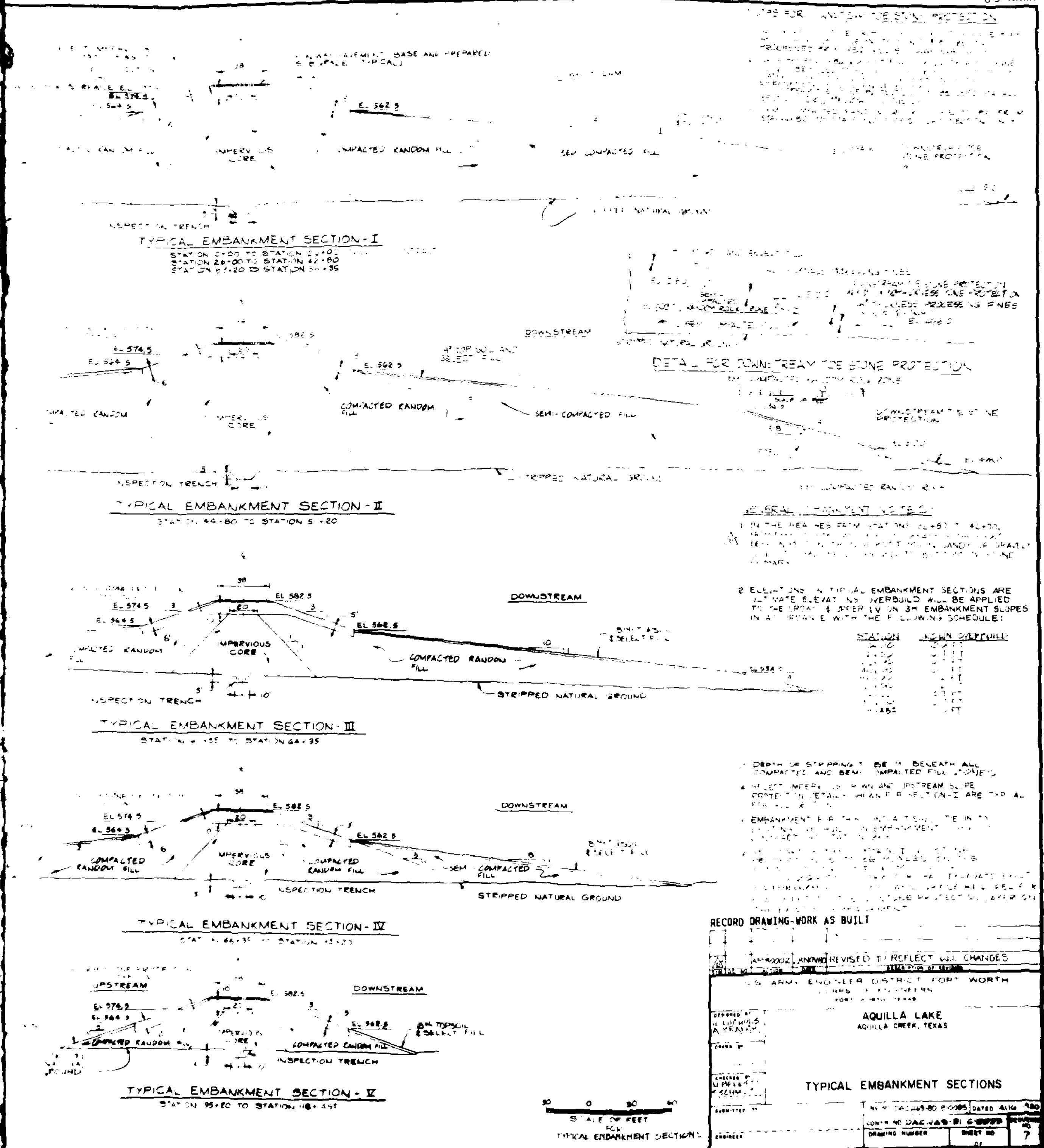


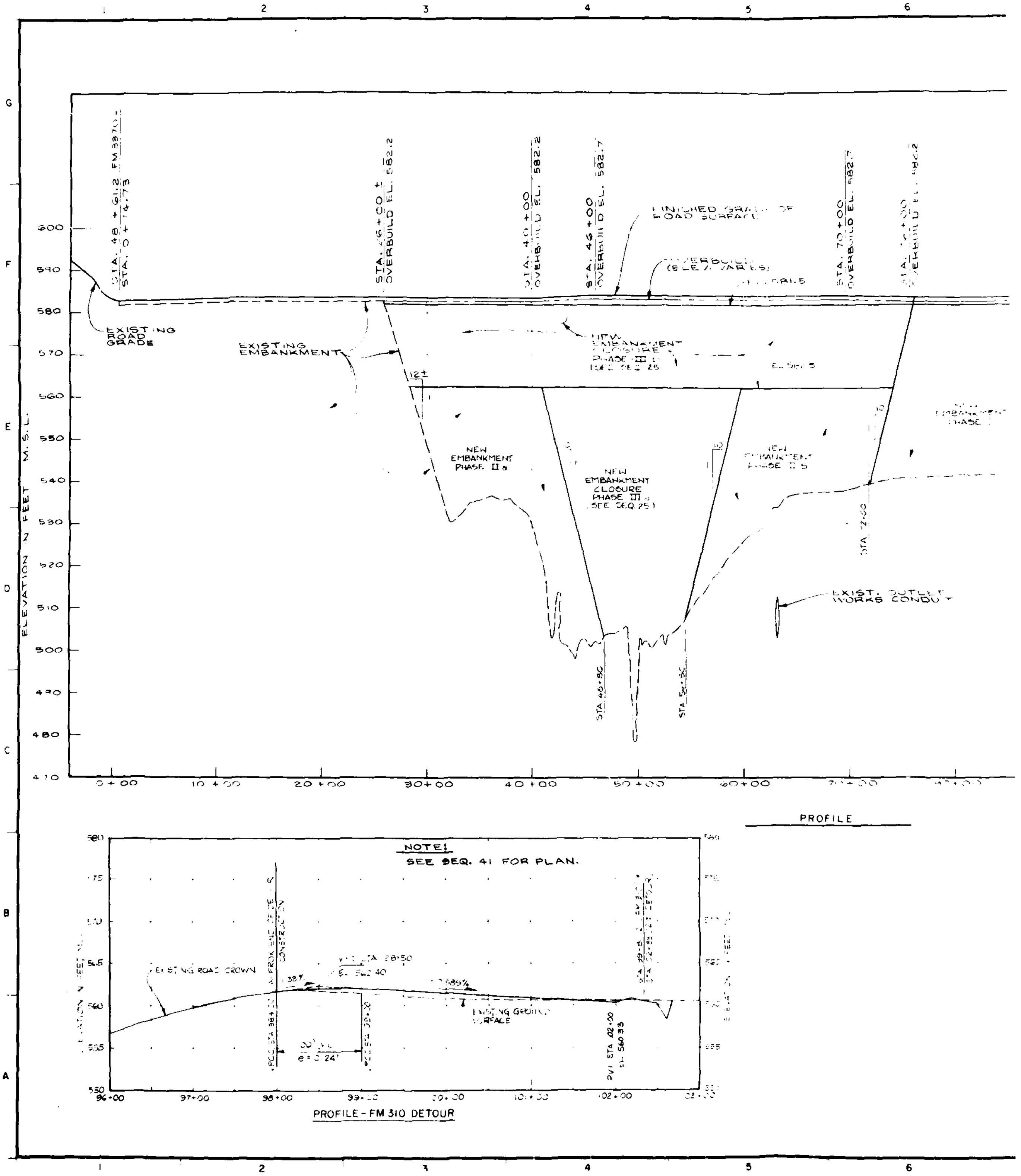
TYPICAL EMBANKMENT SECTION - IV
STATION 66+35 TO STATION 93+20

EMBANKMENT SECTION	REACH BY STATION	GENERAL LOCATION
I	STA 0+00 TO STA 42+80	RT ABUTMENT
TRANSITION	STA 42+80 TO STA 44+80	
II	STA 44+80 TO STA 51+20	FLOODPLAIN
TRANSITION	STA 51+20 TO STA 53+20	
I	STA 53+20 TO STA 58+35	NEAR LT ABUTMENT
TRANSITION	STA 58+35 TO STA 60+35	
III	STA 60+35 TO STA 64+35	OUTLET WORKS
TRANSITION	STA 64+35 TO STA 66+35	
IV	STA 66+35 TO STA 93+20	LT ABUTMENT
TRANSITION	STA 93+20 TO STA 99+80	
V	STA 99+80 TO STA 118+45±	EXTREME LT ABUTMENT

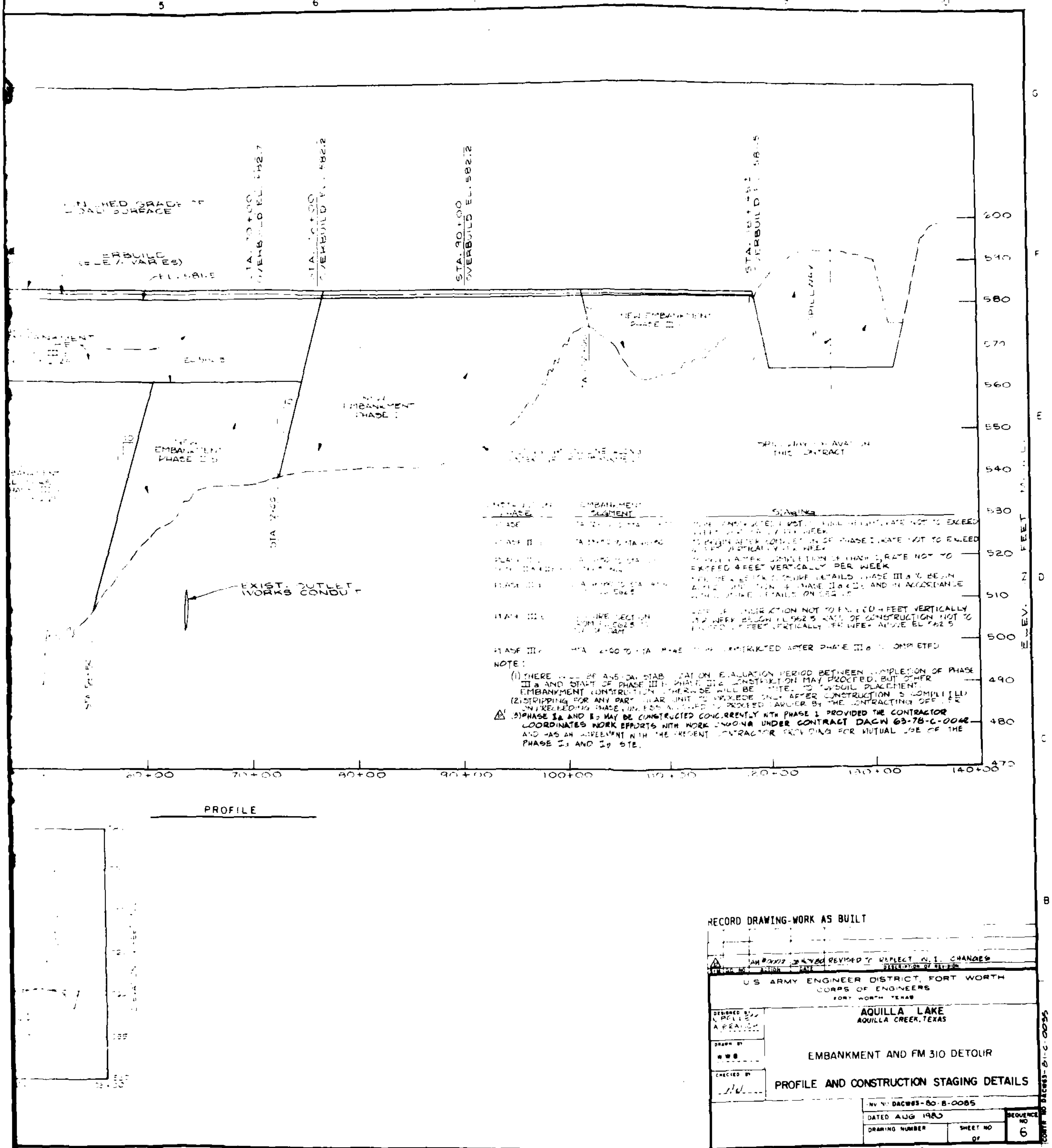


TYPICAL EMBANKMENT SECTION - V
STATION 95+20 TO STATION 118+45±


U.S. ARMY
TYPICAL EMBANKMENT SECTION - I
STATION 26+00 TO STATION 42+80
TYPICAL EMBANKMENT SECTION - II
STATION 44+80 TO STATION 5 +20
DOWNSTREAM
EL 574.5
EL 564.5
EL 582.5
EL 562.5
IMPERVIOUS CORE
COMPACTED RANDOM FILL
SEMI-COMPACTED FILL
STRIPPED NATURAL GROUND
INSPECTION TRENCH
DETAIL FOR DOWNSTREAM TOE STONE PROTECTION
TYPICAL EMBANKMENT SECTION - III
STATION 64+35
TYPICAL EMBANKMENT SECTION - IV
UPSTREAM
TYPICAL EMBANKMENT SECTION - V
STATION 95+60 TO STATION 118+45
3H TOPSOIL & SELECT FILL
SCALE OF FEET FOR TYPICAL EMBANKMENT SECTIONS
2 ELEVATIONS IN TYPICAL EMBANKMENT SECTIONS ARE ULTIMATE ELEVATIONS. OVERBUILD WILL BE APPLIED TO THE CROWN & UPPER 1V ON 3H EMBANKMENT SLOPES IN ACCORDANCE WITH THE FOLLOWING SCHEDULE:
STATION
CROWN OVERBUILD
RECORD DRAWING-WORK AS BUILT
REVISED TO REFLECT W.I. CHANGES
U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS
AQUILLA LAKE
AQUILLA CREEK, TEXAS
TYPICAL EMBANKMENT SECTIONS
PLATE 3



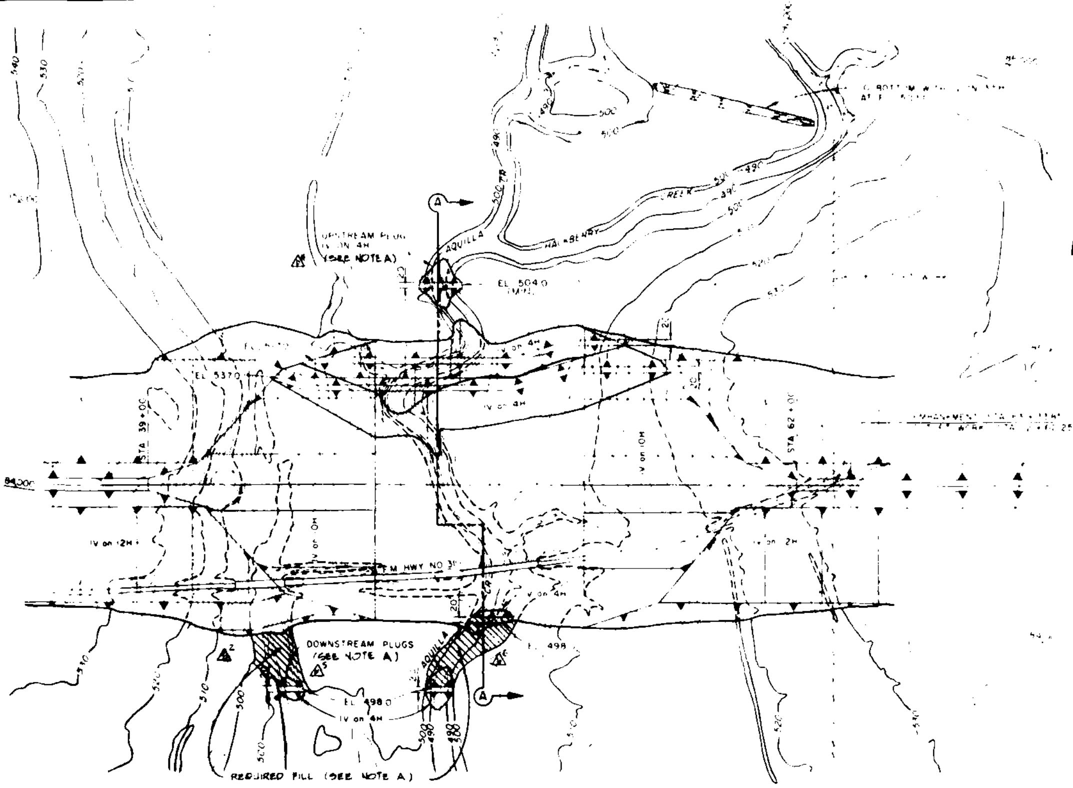
STA. 48 + 61.2 FM 3370 =
STA. 0 + 14.73
STA. 26 + 00 ±
OVERBUILD EL. 582.2
STA. 40 + 00
OVERBUILD EL. 582.2
STA. 46 + 00
OVERBUILD EL. 582.7
STA. 70 + 00
OVERBUILD EL. 582.7
FINISHED GRADE OF ROAD SURFACE
OVERBUILD (ELEV. VARIES)
EXISTING ROAD GRADE
EXISTING EMBANKMENT
NEW EMBANKMENT CLOSURE PHASE III
NEW EMBANKMENT PHASE II
NEW EMBANKMENT CLOSURE PHASE III (SEE SEQ. 25)
EXIST. OUTLET WORKS CONDUIT
ELEVATION FEET M.S.L.
STA 46+80
STA 54+80
0+00
10+00
20+00
30+00
40+00
50+00
60+00
PROFILE
NOTE:
SEE SEQ. 41 FOR PLAN.
EXISTING ROAD CROWN
EXISTING GROUND SURFACE
PVI STA 102+00
EL 560.33
96+00
97+00
98+00
99+00
100+00
101+00
102+00
PROFILE - FM 310 DETOUR



STA. 90+00
OVERBUILD EL. 582.2
SPILLWAY
EXIST. OUTLET
WORKS CONDUIT
NEW EMBANKMENT
PHASE II
SPILLWAY EXCAVATION
THIS CONTRACT
600
590
580
570
560
550
540
530
520
510
500
490
480
470
ELEV. FEET
60+00
70+00
80+00
90+00
100+00
110+00
120+00
130+00
140+00
PROFILE
STAGING
EXCEED 4 FEET VERTICALLY PER WEEK
NOTE:
EMBANKMENT CONSTRUCTION
(3) PHASE Ia AND Ib MAY BE CONSTRUCTED CONCURRENTLY WITH PHASE I PROVIDED THE CONTRACTOR COORDINATES WORK EFFORTS WITH WORK ONGOING UNDER CONTRACT DACW 63-78-C-0042
RECORD DRAWING-WORK AS BUILT
REVISED TO REFLECT N.I. CHANGES
U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH TEXAS
AQUILLA LAKE
AQUILLA CREEK, TEXAS
EMBANKMENT AND FM 310 DETOUR
PROFILE AND CONSTRUCTION STAGING DETAILS
DACW63-80-B-0085
DATED AUG 1980
DRAWING NUMBER
SHEET NO
SEQUENCE NO
6

PLATE 4

CORPS OF ENGINEERS



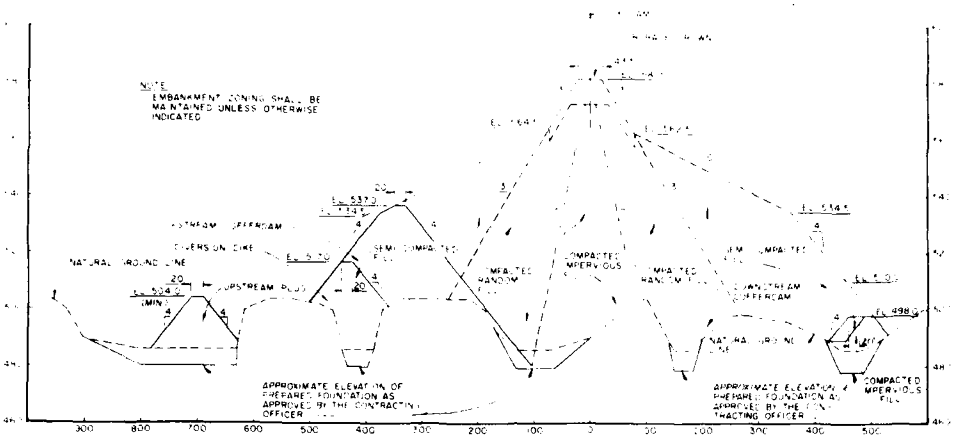
PLAN

200 0 200 400
SCALE OF FEET

NOTE: A

THE UPSTREAM AND DOWNSTREAM PLUGS SHALL BE CONSTRUCTED WITH SEMI-COMPACTED FILL.
THE AREA BETWEEN THE EMBANKMENT TOE AND THE DOWNSTREAM PLUGS SHALL BE FILLED TO EL. 500.0 WITH SEMI-COMPACTED FILL AFTER EMBANKMENT FILL IS ABOVE EL. 500. GRADE FILL TO DRAIN AWAY FROM THE EMBANKMENT.

US ARMY



SECTION A-A

AQUILLA LAKE - EMBANKMENT COMPLETION
EMBANKMENT CLOSURE STAGING NOTES:

1. SEE SEQUENCE NO. 6 FOR EMBANKMENT CONSTRUCTION STAGING
2. SPILLWAY EXCAVATION TO PROCEED AT LEAST AT RATE TO SUPPLY MATERIALS FOR SEMI-COMPACTED FILL.
3. CONSTRUCT MAIN EMBANKMENT OUTSIDE OF CLOSURE SECTION (PHASE I, IIa & IIb) TO ELEVATION 562.5 IN ACCORDANCE WITH EMBANKMENT CONSTRUCTION STAGING. SEE SEQ NO. 6, RATE OF PLACEMENT NOT TO EXCEED 4 FEET VERTICALLY EACH WEEK.
4. MAINTAIN OUTLET WORKS GATES IN OPEN POSITION. NOTE: INVERT AT ELEVATION 503. ACTUAL DIVERSION WILL NOT BEGIN UNTIL IMPOUNDMENT REACHES INVERT ELEVATION.
5. CONSTRUCT CHANNEL PLUGS
6. CONSTRUCT DIVERSION DIKE, UPSTREAM AND DOWNSTREAM COFFERDAMS IN THE DRY.
7. CONSTRUCT EMBANKMENT CLOSURE SECTION TO ELEVATION 537.5 RATE OF PLACEMENT NOT TO EXCEED 4 FEET VERTICALLY EACH WEEK.
8. CONSTRUCT EMBANKMENT CLOSURE SECTION TO ELEVATION 562.5 RATE OF PLACEMENT NOT TO EXCEED 4 FEET VERTICALLY EACH WEEK.

(PHASE III A)

9. CONSTRUCT EMBANKMENT CLOSURE SECTION TO FULL HEIGHT. RATE OF PLACEMENT NOT TO EXCEED 2.5 FEET EACH WEEK (PHASE IIIb).
10. CONTRACTOR TO BEGIN CLOSURE SEQUENCE ONLY AFTER CONTRACTING OFFICER RECEIVES CONTRACTOR'S WRITTEN STATEMENT OF INTENT AND REQUEST TO BEGIN CLOSURE AT LEAST 60 CALENDAR DAYS IN ADVANCE OF HIS ANTICIPATED START OF CLOSURE SEQUENCE. ALSO INITIATION OF CLOSURE SEQUENCE WILL BE ALLOWED ONLY AFTER CONTRACTING OFFICER'S REVIEW AND APPROVAL OF THAT PORTION OF THE CONTRACTOR'S CPM WHICH AFFECTS OR INCLUDES CLOSURE WORK ITEMS.
11. ITEMS 2 THRU 4 MAY PROCEED CONCURRENTLY TO THE EXTENT ALLOWED BY STAGING DETAILS, SEE SEQ NO 6.
12. ITEM 5 TO BE UNDERTAKEN ONLY AFTER ITEMS 3 AND 4 ARE ESSENTIALLY COMPLETE.
13. ITEM 6 TO BE CONSTRUCTED ONLY AFTER ITEM 5 IS COMPLETED AND CARE OF WATER AND FOUNDATION PREPARATION WITHIN THE LIMITS OF CLOSURE SECTION IS COMPLETED AND APPROVED BY THE CONTRACTING OFFICER.
14. ITEMS 6 THRU 8 TO BE COMPLETED IN SEQUENCE.
15. ITEMS 1 THRU 7 SHALL BE COMPLETED PRIOR TO COMMENCEMENT OF ITEM 9.

NOTE:
△ DELETED NOTE 15, ITEM 1 AT CONTRACTORS REQUEST

RECORD DRAWING-WORX AS BUILT

SYMBOL		ACTION	DATE	DESCRIPTION OF REVISION
△1	-	AS-BUILT	15 JUL 85	REVISED TO REFLECT AS-BUILT CHANGES
△6		AM #0002	28 NOV 80	GENERAL REVISIONS

U S ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH TEXAS

DESIGNED BY: A BRANCH
DRAWN BY:
CHECKED BY: T. SCHMIDT

AQUILLA LAKE
AQUILLA CREEK, TEXAS

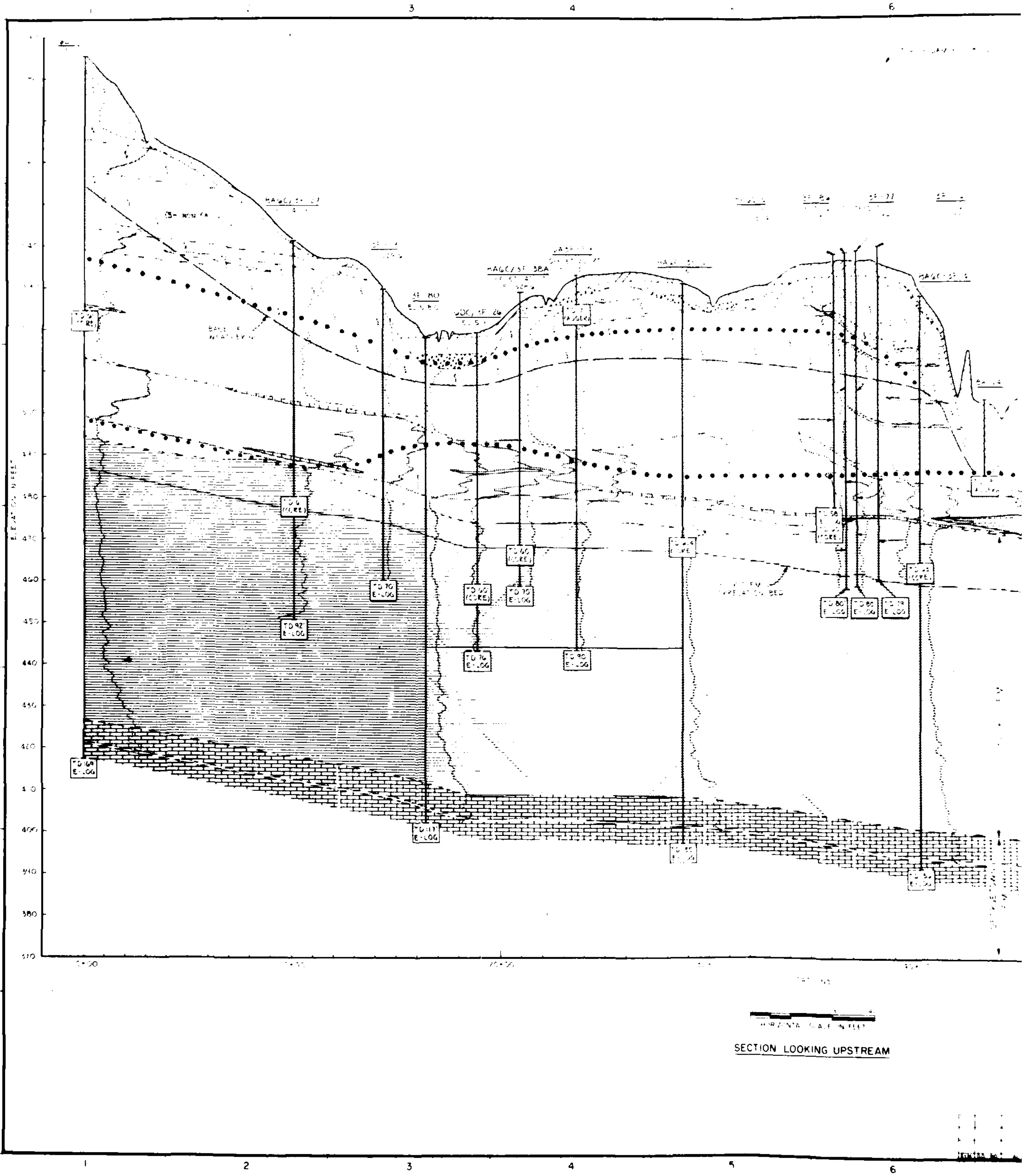
FLOOD PLAIN EMBANKMENT

EMBANKMENT CLOSURE PLAN AND SECTION

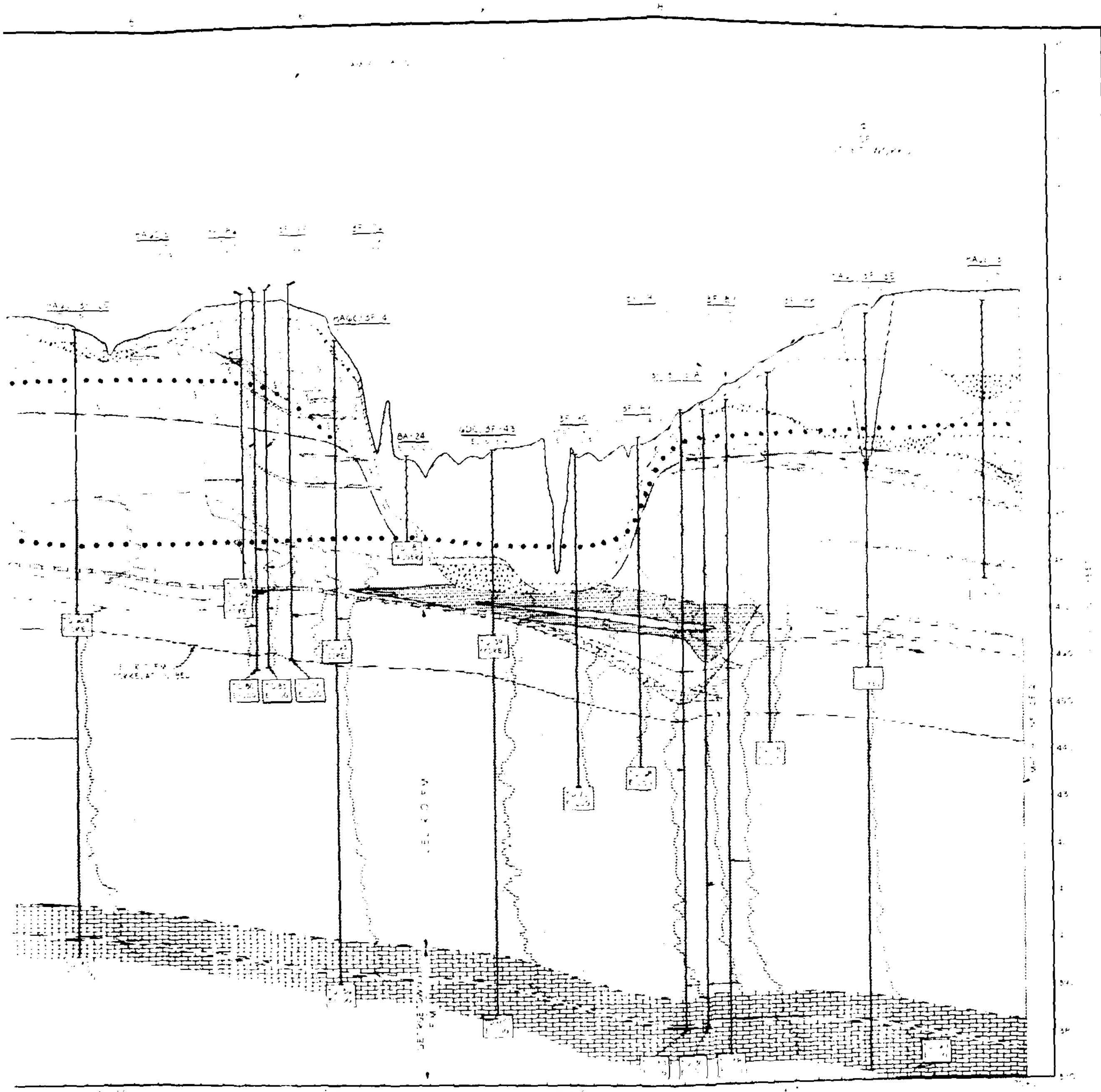
SUBMITTED BY:
ENGINEER
INV. NO. DACW63-80-C-0085 DATED AUG. 1980
CONTR NO DACW63-81-C-0039
DRAWING NUMBER
SHEET NO. OF
SEQUENCE NO. 25

DACW63-81-C-0039

PLATE 5



SECTION LOOKING UPSTREAM



SECTION LOOKING UPSTREAM

U.S. ARMY ENGINEER DISTRICT, FORT WORTH

AQUILLA LAKE

EMBANKMENT

GEOLOGIC PROFILE

(EMBANKMENT - SECTION A-A)

DACW63-80-B-0085

DATED AUG 1980

DESIGNED BY G. RIEDE

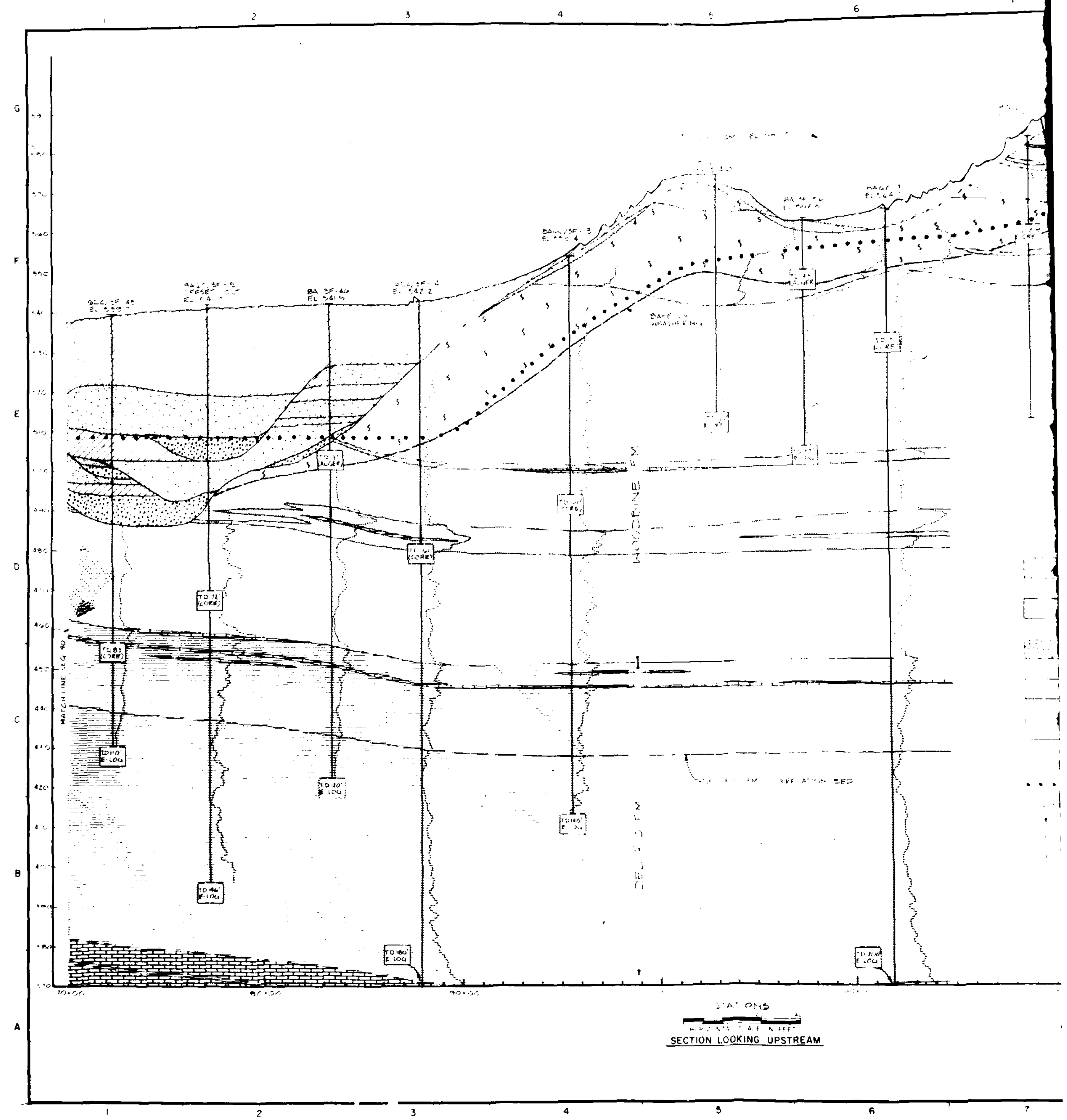
CHECKED BY SAMUELS

DRAWING NUMBER

SHEET NO OF

SEQUENCE NO 103

PLATE 6


WOODBINE
STATIONS
SECTION LOOKING UPSTREAM

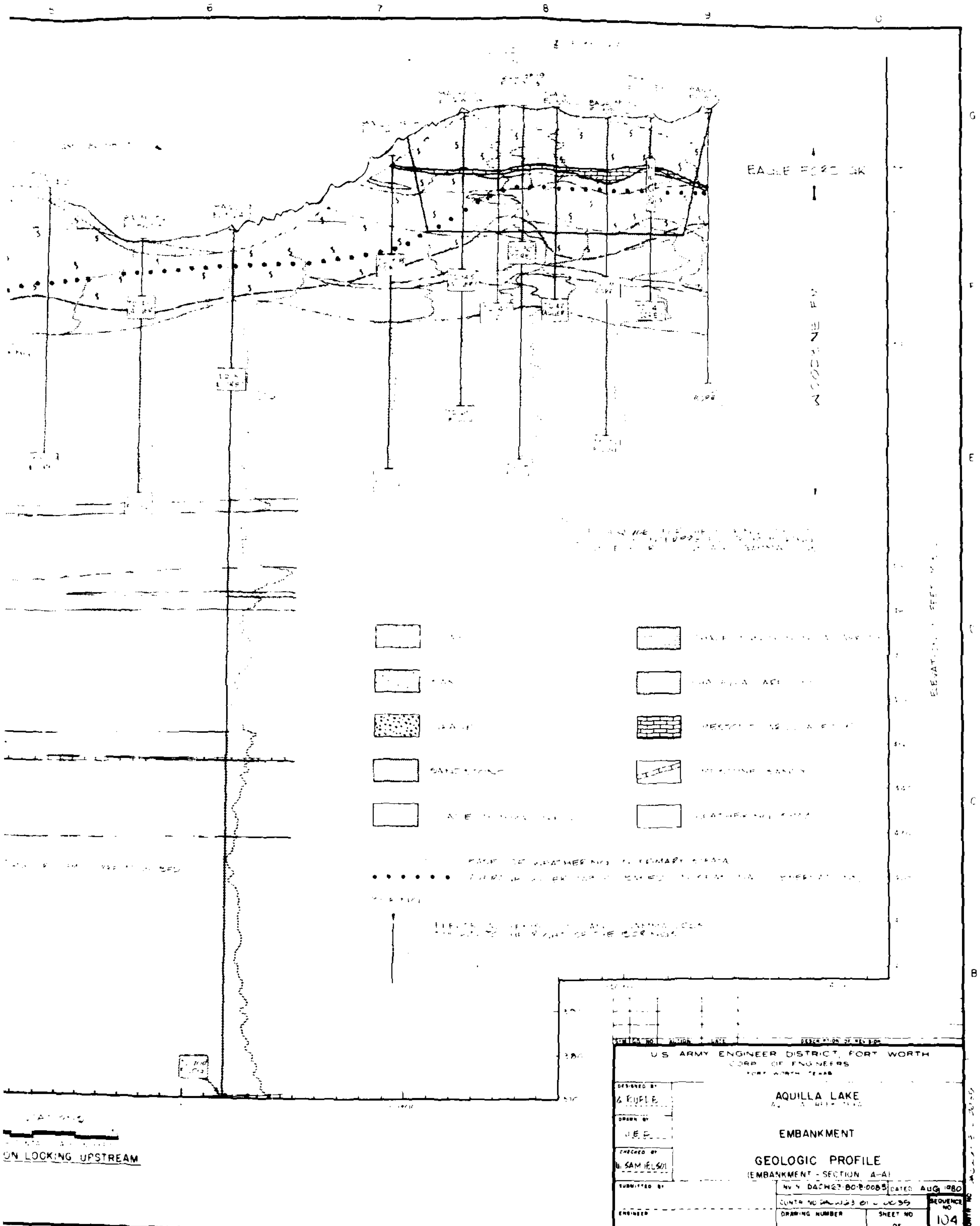
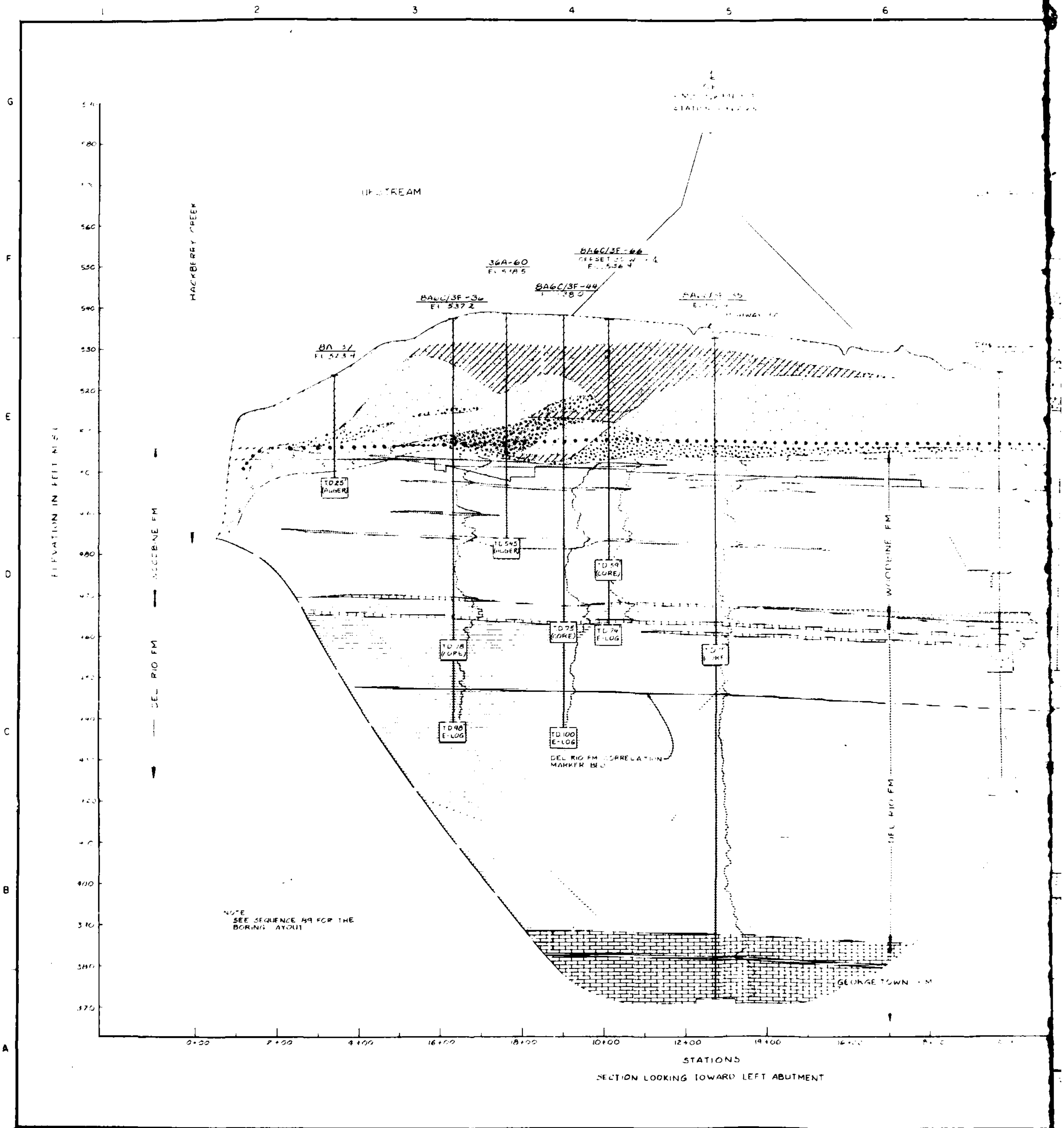
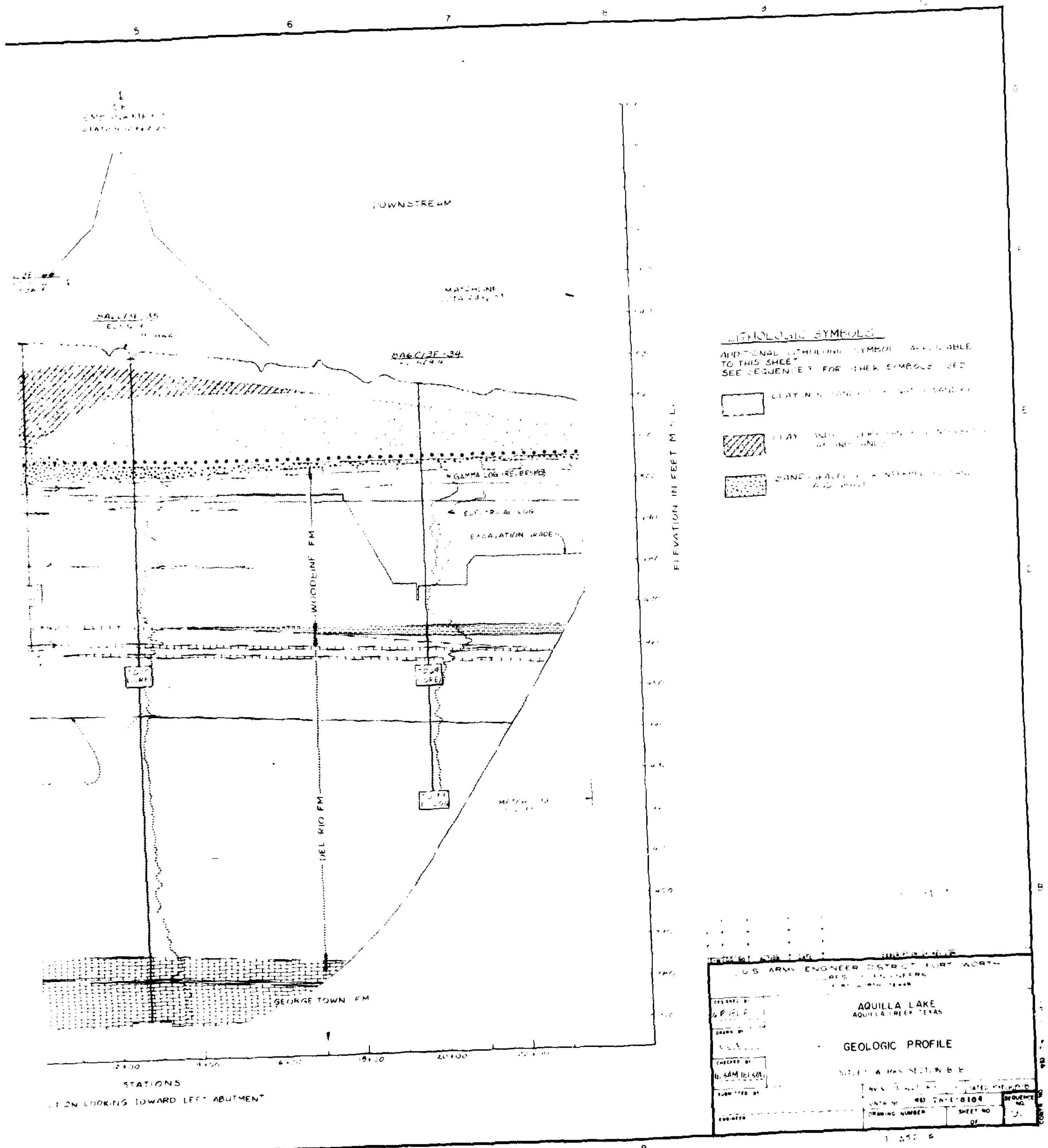
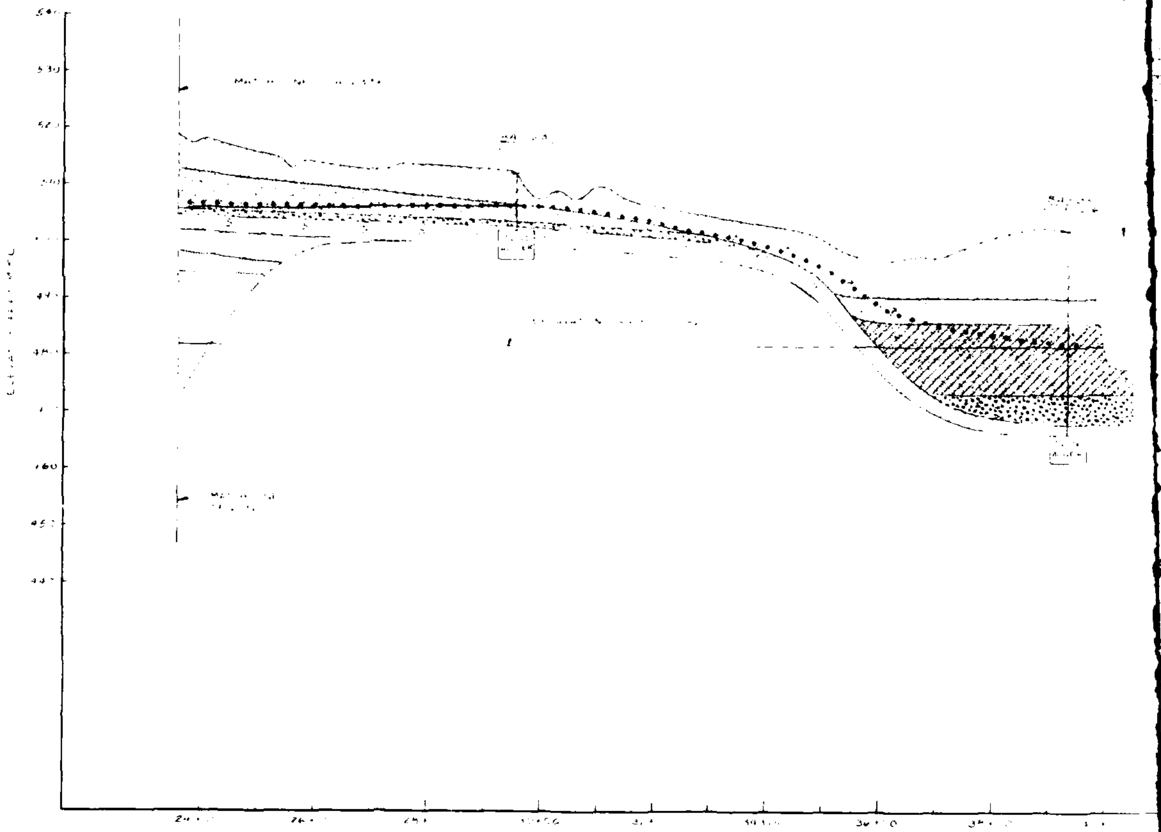

EAGLE FORD SH
ON LOOKING UPSTREAM
U S ARMY ENGINEER DISTRICT, FORT WORTH
CORP OF ENGINEERS
FORT WORTH TEXAS
DESIGNED BY
DRAWN BY
CHECKED BY
SUBMITTED BY
ENGINEER
AQUILLA LAKE
EMBANKMENT
GEOLOGIC PROFILE
(EMBANKMENT - SECTION A-A)
DACW63-80-B-0085
DATED AUG 1980
DRAWING NUMBER
SHEET NO
OF
SEQUENCE NO
104

PLATE 7



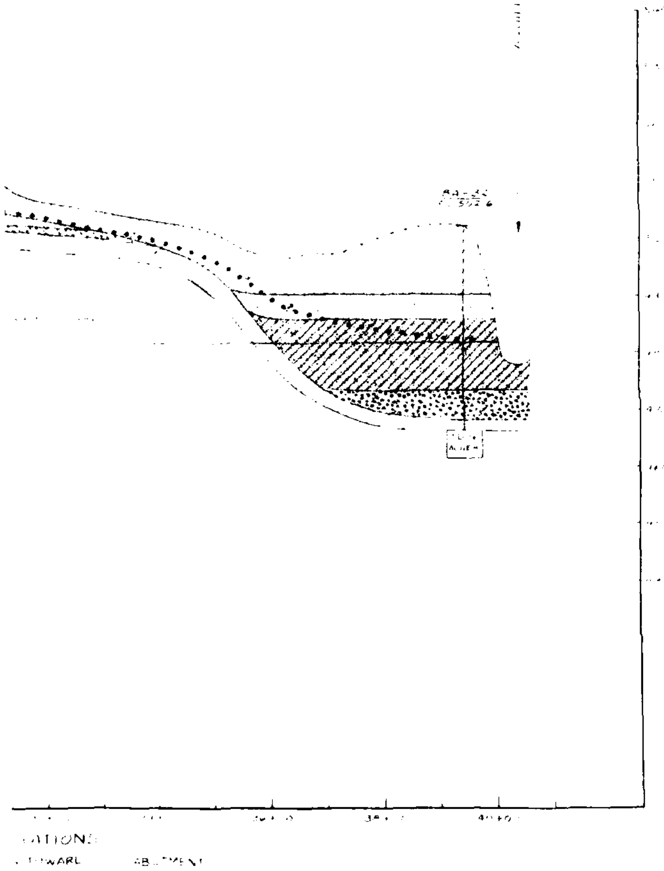
UPSTREAM
HACKBERRY CREEK
ELEVATION IN FEET M.S.L.
BA-37
EL 523.4
BA6C/3F-36
EL 537.2
36A-60
EL 518.5
BA6C/3F-44
BA6C/3F-66
TD 25' (AUGER)
TD 54.5' (AUGER)
TD 59 (CORE)
TD 78 (CORE)
TD 75 (CORE)
TD 74 E-LOG
TD 98 E-LOG
TD 100 E-LOG
WOODBINE FM
DEL RIO FM
DEL RIO FM CORRELATION MARKER BED
GEORGETOWN FM
NOTE
SEE SEQUENCE 89 FOR THE BORING LAYOUT
STATIONS
SECTION LOOKING TOWARD LEFT ABUTMENT


DOWNSTREAM
BAGC/3F-34
GAMMA LOG (REFERENCE)
ELECTRICAL LOG
EXCAVATION GRADE
WOODBINE FM
DEL RIO FM
GEORGETOWN FM
ELEVATION IN FEET M.S.L.
STATIONS
LITHOLOGIC SYMBOLS
ADDITIONAL LITHOLOGIC SYMBOLS APPLICABLE TO THIS SHEET
U.S. ARMY ENGINEER DISTRICT FORT WORTH
AQUILLA LAKE
AQUILLA CREEK TEXAS
GEOLOGIC PROFILE



STATIONS

SECTION LOOKING TOWARD LEFT ABUTMENT



LITHOLOGIC SYMBOLS

CLAY

CLAY

SAND

US ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS

AQUILLA LAKE
AQUILLA CREEK, TEXAS

GEOLOGIC PROFILE

OUTLET WORKS SECTION B-B

DATED MARCH 1978

CONTR NO DACW63 78-C-0104

DRAWING NUMBER

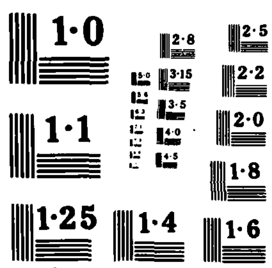
SHEET NO OF

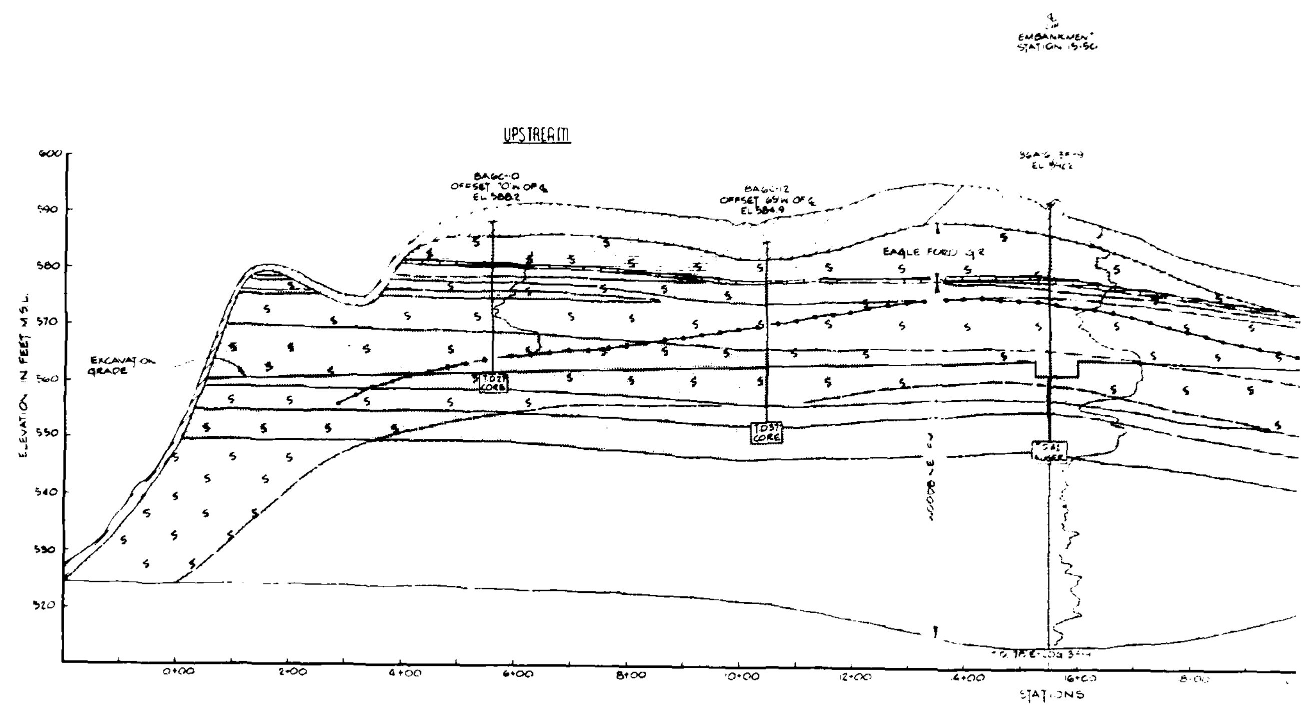
SEQUENCE NO 93

PLATE 9

AD-A168 214 EMBANKMENT CRITERIA AND PERFORMANCE REPORT AQUILLA LAKE AQUILLA CREEK TEXAS BRAZOS RIVER BASIN(U) ARMY ENGINEER DISTRICT FORT WORTH TX DEC 85 2/6

UNCLASSIFIED F/G 13/2 NL


1·0
2·8
2·5
3·15
2·2
3·5
1·1
4·0
2·0
4·5
1·8
1·25
1·4
1·6

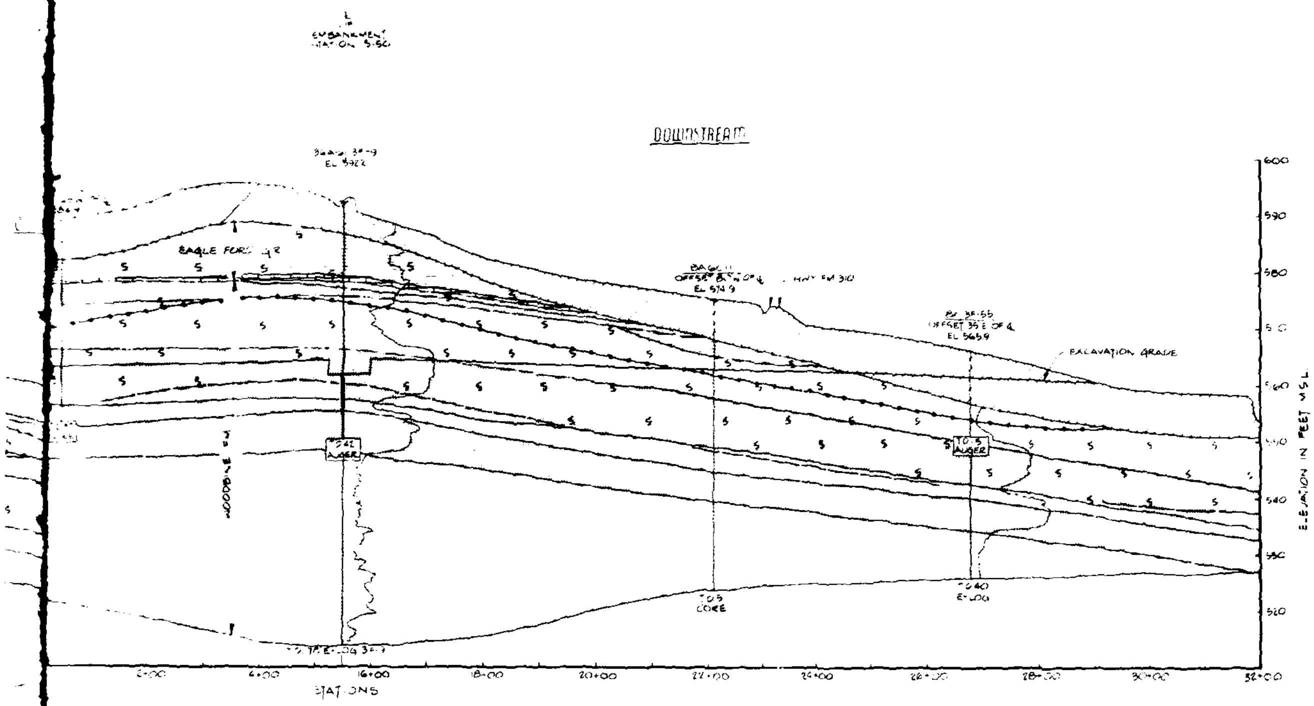


SECTION LOOKING TOWARD LEFT WALL OF SPILLWAY

200 0 200 400

HORIZONTAL SCALE IN FEET

NOTES:
1. THICKNESS OF OVERBURDEN PENETRATED BY OFFSET BORINGS BAGC-10 AND BAGC-12 IS ADJUSTED TO THE GROUND SURFACE IN THE LINE OF SECTION
2. SEE SEQ. FOR THE BORING LAYOUT AND SEQ. FOR LITHOLOGIC SYMBOLS.



SECTION LOOKING TOWARD LEFT WALL OF SPILLWAY

200 0 200 400

HORIZONTAL SCALE IN FEET

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

AQUILLA LAKE

SPILLWAY

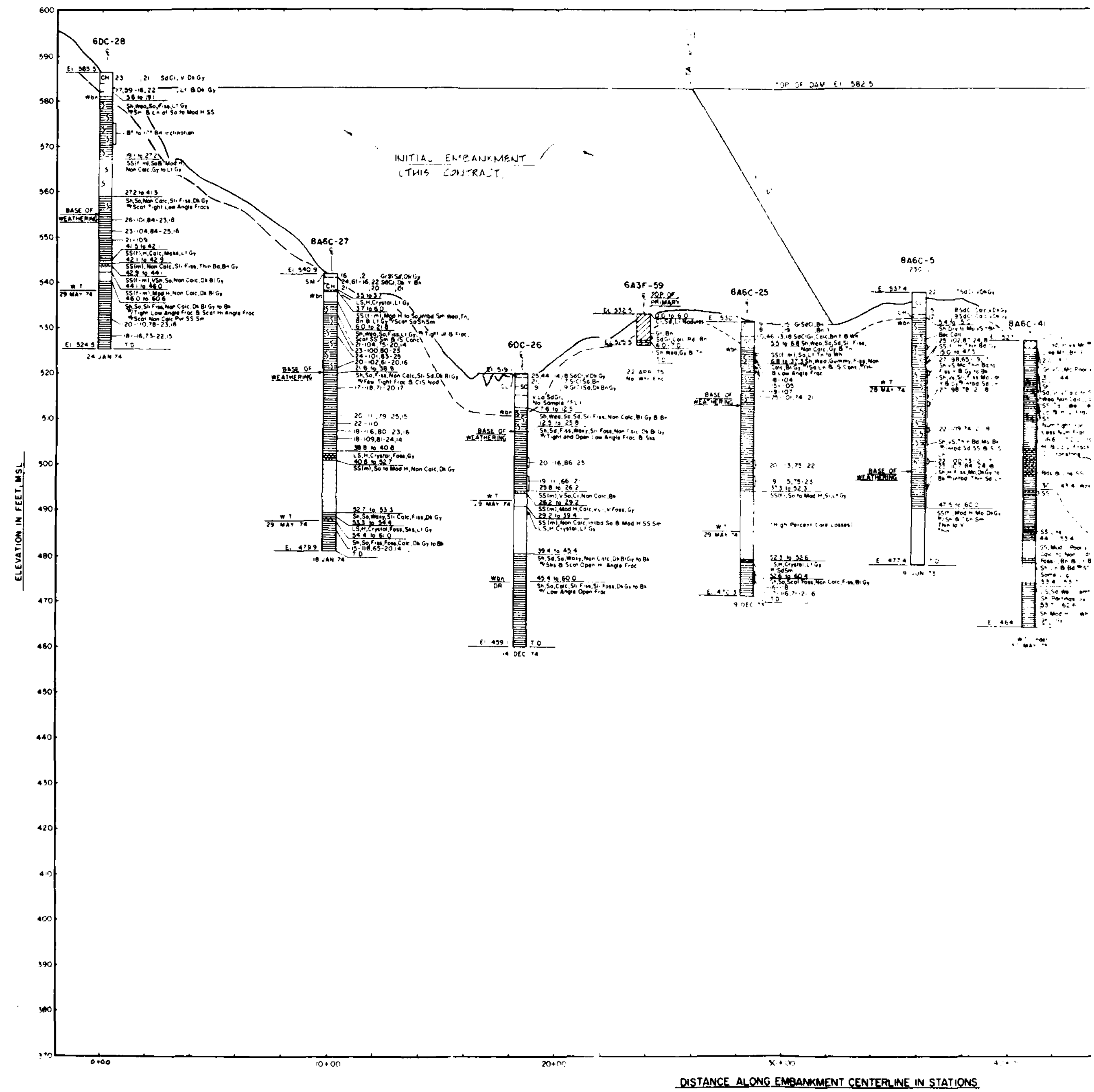
GEOLOGIC PROFILE SECTION C-C

DATED AUG. 1980

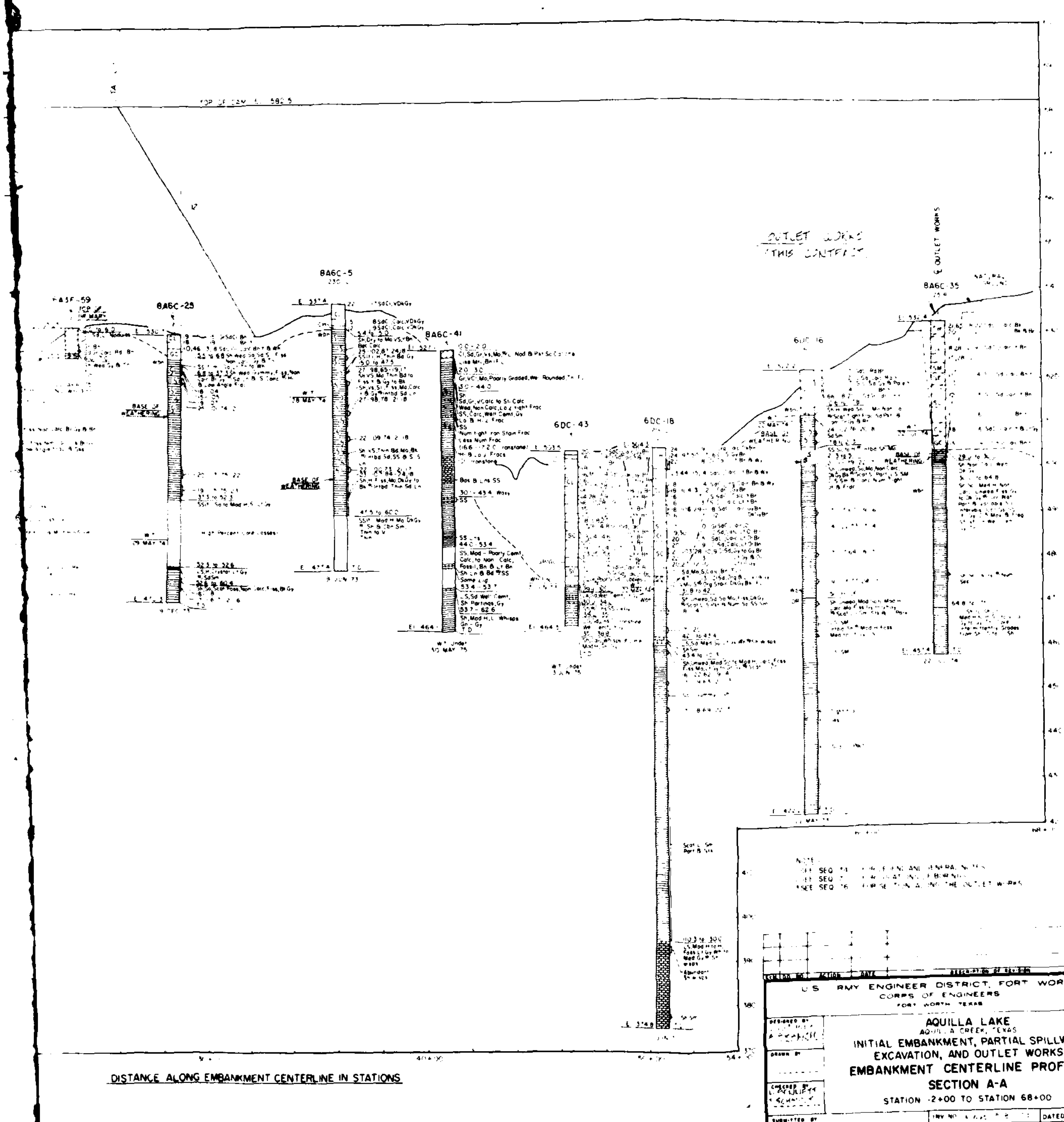
SEQUENCE NO 105

PLATE 10

CORPS OF ENGINEERS



U S ARMY



U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

AQUILLA LAKE
AQUILLA CREEK, TEXAS

INITIAL EMBANKMENT, PARTIAL SPILLWAY EXCAVATION, AND OUTLET WORKS

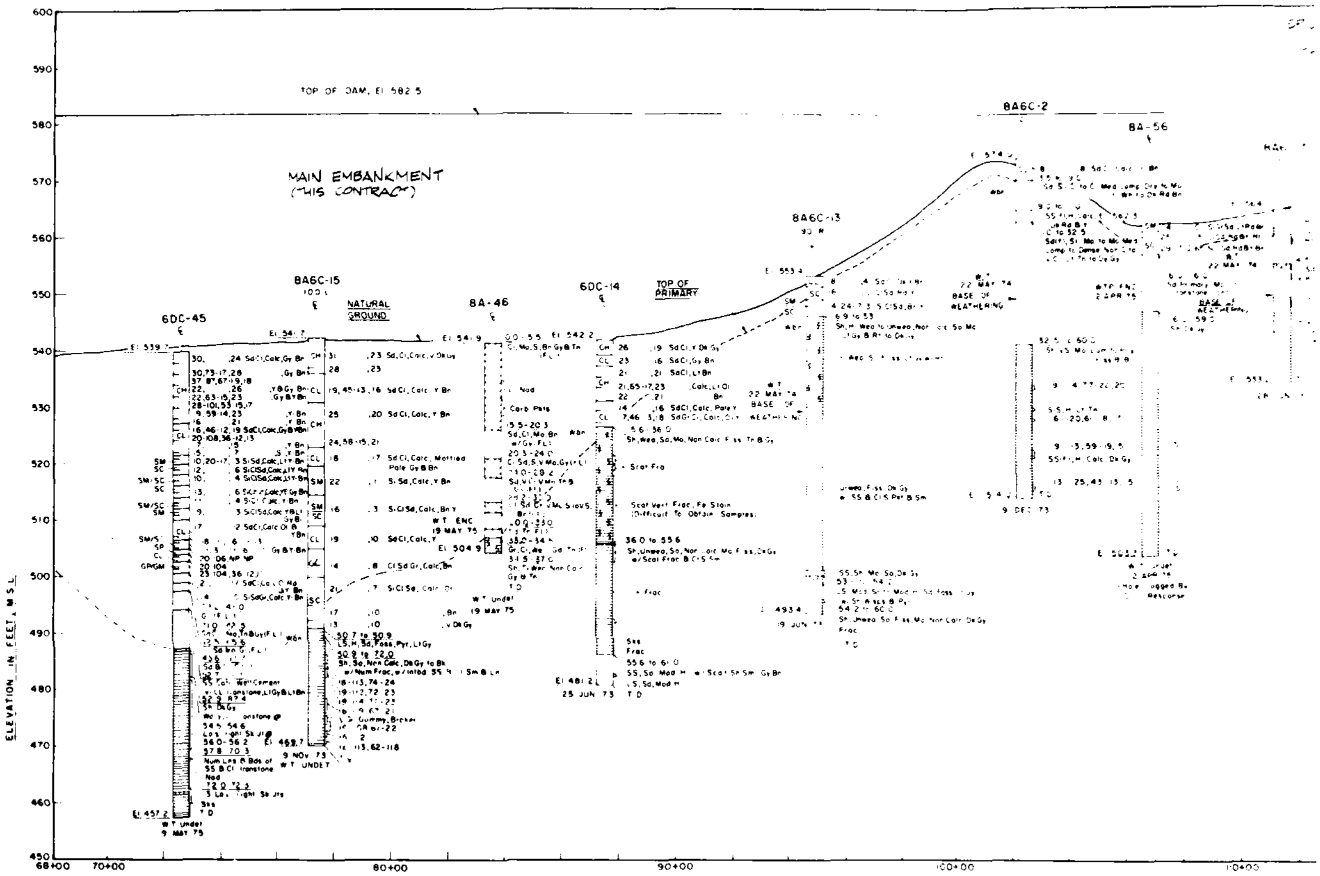
EMBANKMENT CENTERLINE PROFILE

SECTION A-A

STATION -2+00 TO STATION 68+00

DESIGNED BY	
DRAWN BY	
CHECKED BY	
SUBMITTED BY	
ENGINEER	
INV NO	DATED
CONTR NO	
DRAWING NUMBER	SHEET NO OF
SEQUENCE NO	72

PLATE 11



DISTANCE ALONG EMBANKMENT CENTERLINE IN STATIONS

HORIZONTAL SCALE IN FEET

LEGEND

VISUAL CLASSIFICATION

Cl	CLAY OR CLAYEY	Comp	COMPACTED	Med	MEDIUM
Sd	SAND OR SANDY	Jt	JOINT OR JOINTED	D	DENSE
G	GRAVEL OR GRAVELLY	Lam	LAMINATED OR LAMINATIONS	Lo	LOOSE
Si	SILT OR SILTY	Ln	LENSES	Fm	FIRM
Sh	SHALE OR SHALY	Mass	MASSIVE	H	HARD
SS	SANDSTONE	Nod	NODULES	So	SOFT
SiS	SILTSTONE	Org	ORGANIC	S	STIFF
IS	IRONSTONE	Pkts	POCKETS	Dk	DARK
ClS	CLAYSTONE	Part	PARTING OR PARTINGS	Lt	LIGHT
LS	LIMESTONE	Wkly	WEAKLY	Sat	SATURATED
Lig	LIGNITE OR LIGNITIC	Mod	MODERATELY	Mo	MOIST
Li	LIME OR LIMY	Horz	HORIZONTAL	W T	WATER TABLE
Pyr	PYRITE OR PYRITIC	Irreg	IRREGULAR	No Wtr Enc	NO WATER ENCOUNTERED
Wea	WEATHERED	Num	NUMEROUS	W T Undet	WATER TABLE UNDETERMINED
Sks	SLICKENSIDED OR SLICKENSIDE	Occ	OCCASIONAL	TD	TOTAL DEPTH
Sm	SEAM	Predom	PREDOMINATELY	FL	FIELD LOG
Str	STREAK	Sli	SLIGHT	Bk	BLACK
Bd	BED OR BEDDED	Scat	SCATTERED	Bn	BROWN
Calc	CALCAREOUS	Zn	ZONE OR ZONES	Gy	GRAY
Cbn	CARBON OR CARBONACEOUS	v	VERY	Gn	GREEN
Crssbd	CROSSBEDDED	w/	WITH	Ol	OLIVE
Frag	FRAGMENTS OR FRAGMENTED	Hi	HIGH OR HIGHLY	Or	ORANGE
Frac	FRACTURED OR FRACTURE	c	COARSE } Describes grain size of granular materials	Rd	RED
Fri	FRIABLE	f	FINE	Tn	TAN
Cem	CEMENTED	m	MEDIUM	Y	YELLOW
Crystal	CRYSTALLINE			Rt	RUST
Conc	CONCRETIONS			Gd	GOLD
Intbd	INTERBEDDED			Wh	WHITE
Freq	FREQUENT			Bl	BLUE
Fiss	FISSILE				
Foss	FOSSIL OR FOSSILIFEROUS				
Prly	POOR OR POORLY				

STRATIGRAPHIC CLASSIFICATION

CLAY — SHALE

SAND — LIMESTONE

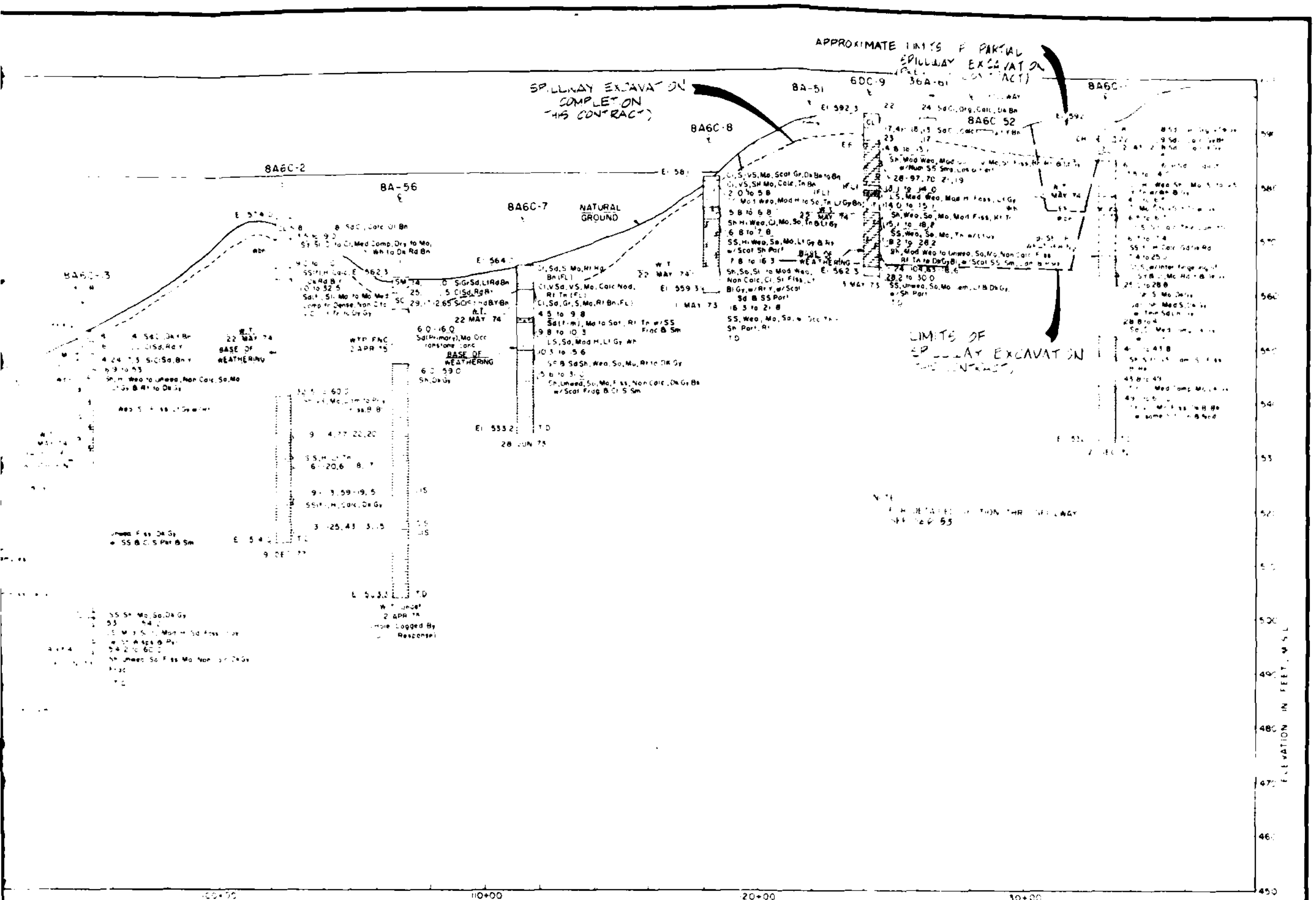
SANDSTONE — SYMBOL INDICATES WEATHERING

DESIGNATION	FORMATION
EF	EAGLE FORD
WP	WOODBINE
DR	DEL RIO
GT	GEORGETOWN

LABORATORY CLASSIFICATION

CH INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
CL INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
SM SILTY SANDS, SAND-SILT MIXTURES
SC CLAYEY SANDS, SAND-CLAY MIXTURES
GC CLAYEY-GRAVELS, GRAVEL SAND CLAY MIXTURES
SP POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES
GP POORLY GRADED GRAVEL OR SAND GRAVEL MIXTURES, LITTLE OR NO FINES

ABSENCE OF GROUND W...
MEAN THAT GROUND WA...
THE VERTICAL REACHE...
2 FIGURES TO THE RIGHT ... WEIGHT, DRY DENSITY, ... WHEN ... IS WATER CONTENT ... SHOWN, THEY ARE ... SHRINKAGE (MC ... WEIGHT (MC-UDW)
3 THE DATE THE BORING...
4 THE NATURAL GROUND ... IS INTERPRETATIVE AN...
5 OVERBURDEN CLASSIF... UNLESS INDICATED ON ... IN ACCORDANCE WITH ...
6 SOIL CLASSIFICATION T... (PRIMARY) MATERIALS IN...
7 SEE SEQ ... FOR L...
8 WHILE THE BORINGS AR... OF SUBSURFACE ... MINOR VARIATIONS IN...



DISTANCE ALONG EMBANKMENT CENTERLINE IN STATIONS

SANDSTONE

LABORATORY CLASSIFICATION

GENERAL NOTES

1. ABSENCE OF GROUND WATER LEVELS ON THE BORING LOGS DOES NOT NECESSARILY MEAN THAT GROUND WATER WILL NOT BE ENCOUNTERED AT THE LOCATION OR WITHIN THE VERTICAL REACHES OF THE BORINGS.
2. FIGURES TO THE RIGHT OF THE BORING LOGS ARE WATER CONTENTS IN PERCENT OF DRY WEIGHT, DRY DENSITY, LIQUID LIMIT, PLASTIC LIMIT, AND LINEAR SHRINKAGE (MC, LL, PL, LS). WHEN ONLY ONE FIGURE IS SHOWN ON THE RIGHT SIDE OF THE BORING LOG IT IS WATER CONTENT IN PERCENT OF DRY WEIGHT (MC). WHEN TWO FIGURES ARE SHOWN, THEY ARE EITHER WATER CONTENT IN PERCENT OF DRY WEIGHT AND LINEAR SHRINKAGE (MC, LS), OR WATER CONTENT IN PERCENT OF DRY WEIGHT AND UNIT DRY WEIGHT (MC-UDW).
3. THE DATE THE BORING WAS COMPLETED IS SHOWN AT THE BOTTOM OF THE LOG.
4. THE NATURAL GROUND LINE SHOWN BETWEEN THE LOGS OF BORINGS IN ALL SECTIONS IS INTERPRETATIVE AND IS NOT NECESSARILY CORRECT.
5. OVERBURDEN CLASSIFICATIONS ARE IN ACCORDANCE WITH LABORATORY RESULTS UNLESS INDICATED ON THE LOGS OF BORINGS. ALL PRIMARY CLASSIFICATIONS ARE IN ACCORDANCE WITH FIELD LOGS.
6. SOIL CLASSIFICATION TERMINOLOGY WAS USED TO DESCRIBE THE CONSISTENCY OF SHALE (PRIMARY) MATERIALS IN BORINGS 8A6C-1 THRU 8A6C-6.
7. SEE SEQ [illegible] FOR LOCATIONS OF SECTIONS AND BORINGS.
8. WHILE THE BORINGS AND GEOLOGIC STRUCTURAL INTERPRETATIONS ARE REPRESENTATIVE OF THIS AREA [illegible] FOR THE VERTICAL AND HORIZONTAL REACHES SHOWN, MINOR VARIATIONS IN CHARACTERISTICS OF MATERIALS MAY BE ENCOUNTERED.

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY: W. KITCHELL / A. GRAHAM
DRAWN BY: HLR
CHECKED BY: U BFILLE / T SCHMID
SUBMITTED BY:
ENGINEER

AQUILLA LAKE
AQUILLA CREEK, TEXAS

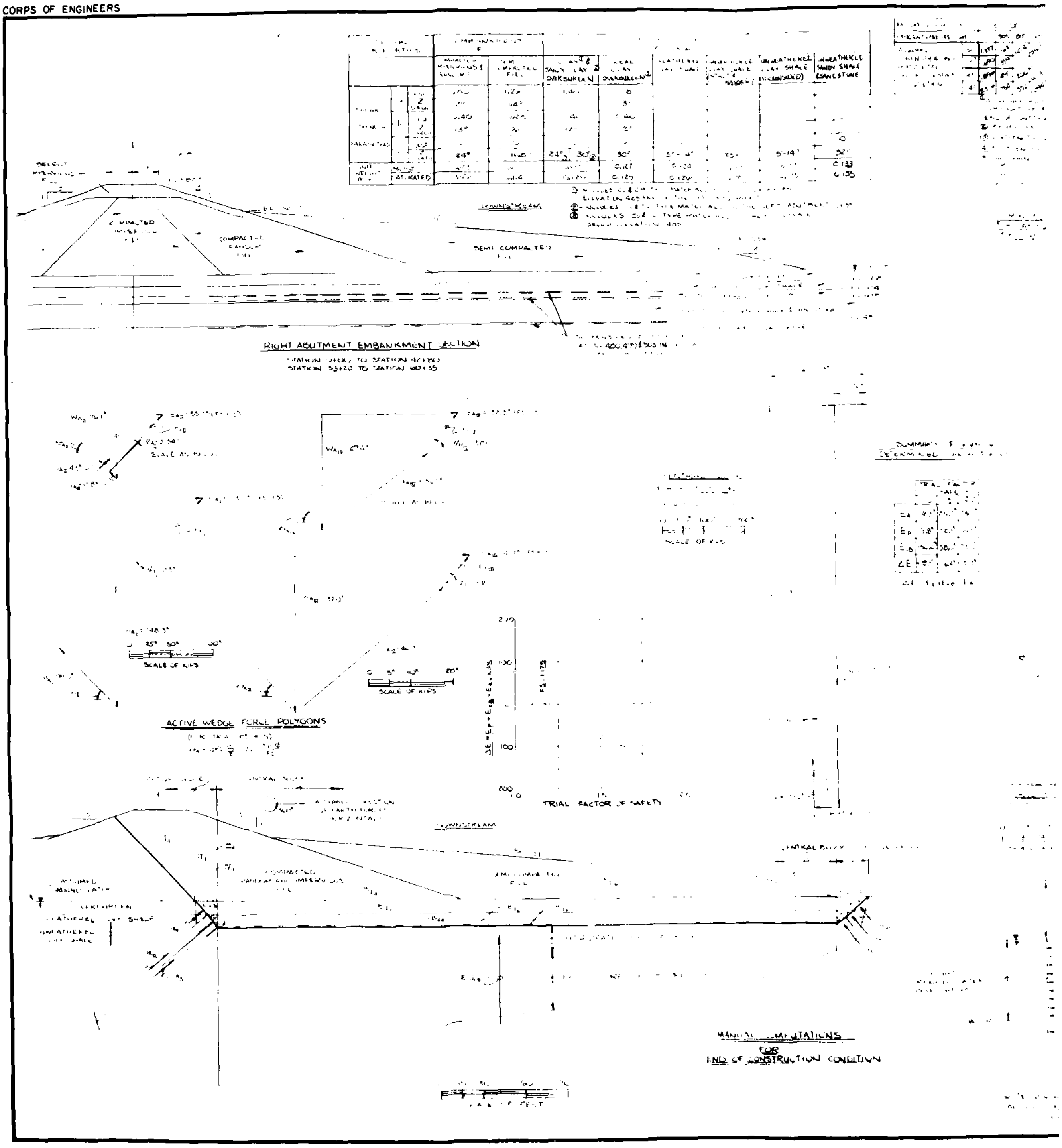
EMBANKMENT CENTERLINE PROFILE-SECTION A-A
(STA 68+00 TO STA 138+00)

INV NO DACW63-80-B-0066 DATED AUG. 1980
CONTR NO DACW63-81-C-0045
DRAWING NUMBER
SHEET NO 0?
SEQUENCE NO 80

PLATE 12

DACW63-81-C-0045

CORPS OF ENGINEERS



U S ARMY

[illegible]		EL 507				EL 504				EL 499				EL 490			
[illegible]			50%	80%	100%		50%	80%	100%		50%	80%	100%		50%	80%	100%
[illegible]	5°	1.377	1.163	1.014	[illegible]	[illegible]	1.187	0.979	0.802	1.514	1.099	[illegible]	[illegible]	1.442	[illegible]	1.010	[illegible]
[illegible]	[illegible]	[illegible]	1.359	—	[illegible]	[illegible]	1.326	—	[illegible]	[illegible]	1.297	—	[illegible]	[illegible]	[illegible]		1.023
[illegible]	[illegible]	[illegible]	[illegible]	1.200	1.03	[illegible]	1.454	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.321	[illegible]	1.102
[illegible]	[illegible]	[illegible]	[illegible]	1.352	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.107	[illegible]	[illegible]		1.206

① ABOVE ARE MINIMUM FACTORS OF SAFETY [illegible] END OF CONSTRUCTION CONDITION

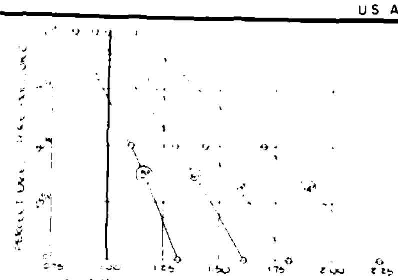
② MINIMUM FS [illegible] FAILURE THRU OVERBURDEN [illegible]

③ [illegible] STRENGTHS USED IN THE EMBANKMENT FILL & OVERBURDEN

④ [illegible] STRENGTHS WITH PORE PRESSURE [illegible] PRIMARY

⑤ THE [illegible] OF 80% [illegible] FS = 1.107 [illegible] FS [illegible] 1.175

SUMMARY OF
MINIMUM COMPUTED FACTORS OF SAFETY
FOR VARIED COMBINATIONS OF SHEAR STRENGTH,
PORE PRESSURE & FAILURE ELEVATION

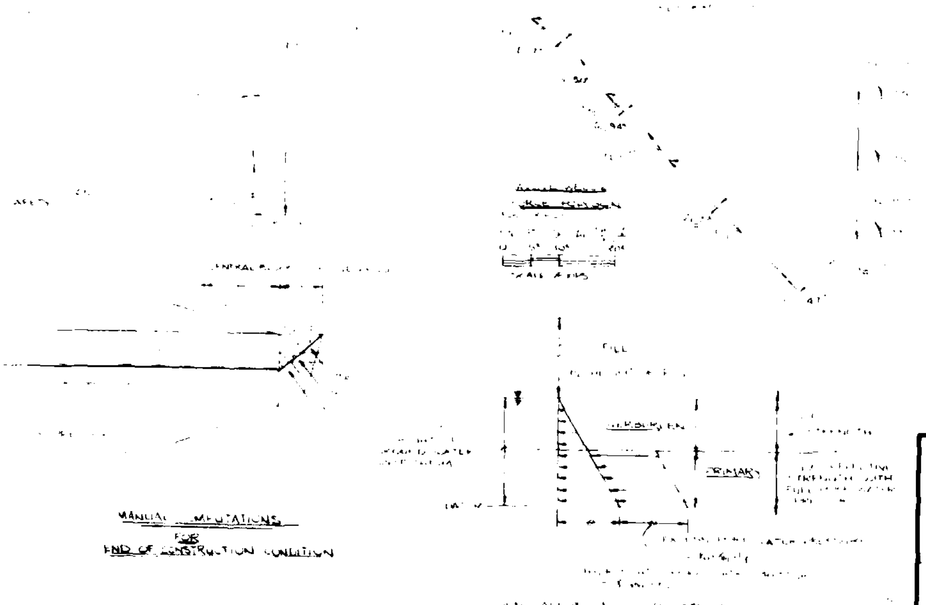


MINIMUM CALCULATED FACTORS OF SAFETY FOR WEDGE FAILURE TANGENT TO EL 499 ALONG A HORIZONTAL PLANE

SUMMARY OF GRAPHICALLY DETERMINED EARTH FORCES

	TRIAL FACTOR OF SAFETY		
	[illegible]	[illegible]	2.0
E_A	[illegible]	[illegible]	[illegible]
E_P	[illegible]	[illegible]	[illegible]
E_B	[illegible]	[illegible]	[illegible]
ΔE	[illegible]	[illegible]	[illegible]

SCALE OF KIPS



GENERAL NOTES

MANUAL COMPUTATIONS FOR END OF CONSTRUCTION CONDITION

BRAZOS RIVER BASIN, TEXAS
AQUILLA LAKE
AQUILLA CREEK, TEXAS

STABILITY ANALYSIS
RIGHT ABUTMENT EMBANKMENT SECTION
END-OF-CONSTRUCTION CONDITION
WEDGE METHOD

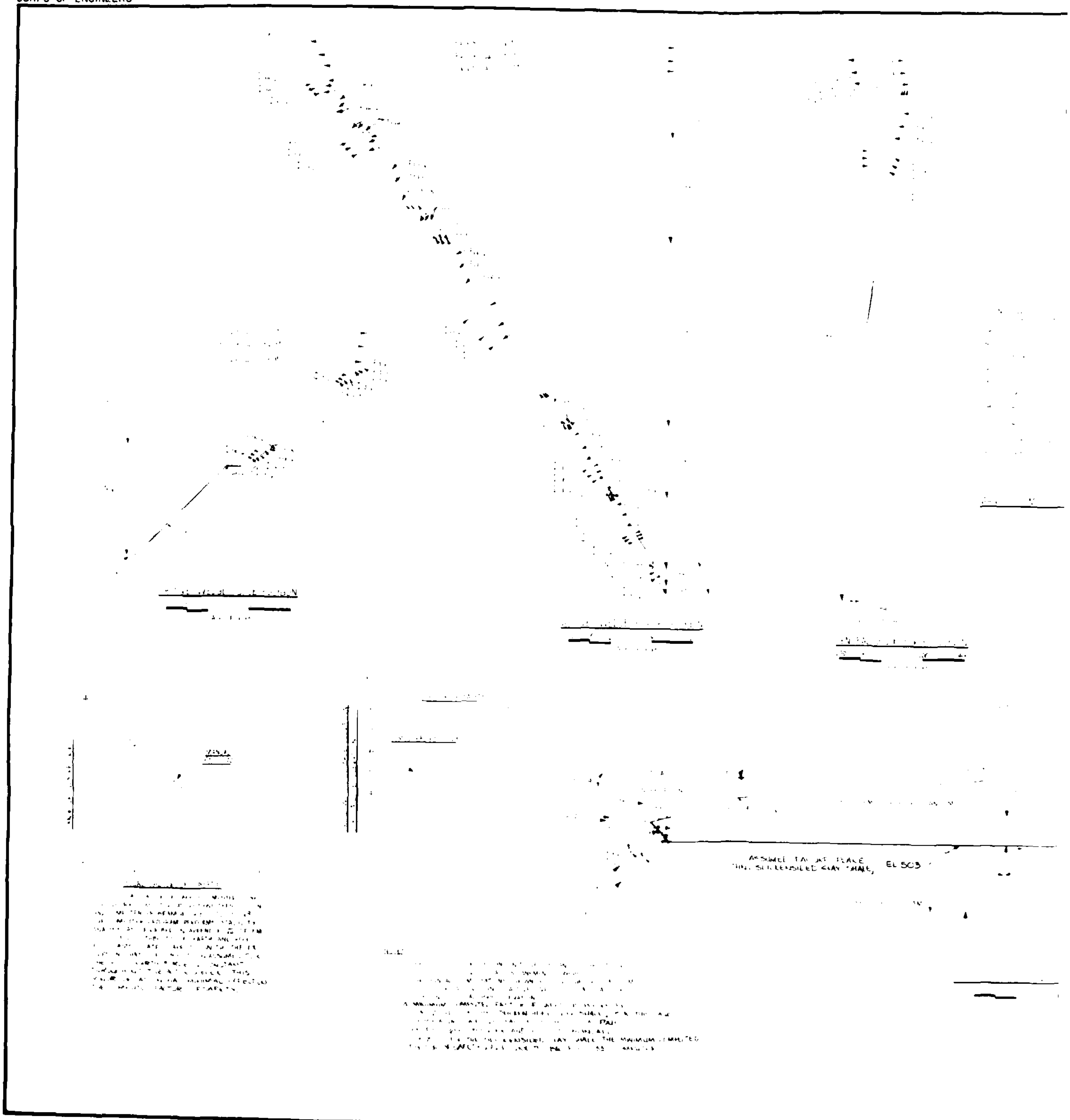
U S ARMY ENGINEER DISTRICT, FORT WORTH — MAY 1976

TO ACCOMPANY FEATURE DESIGN MEMORANDUM NO 7

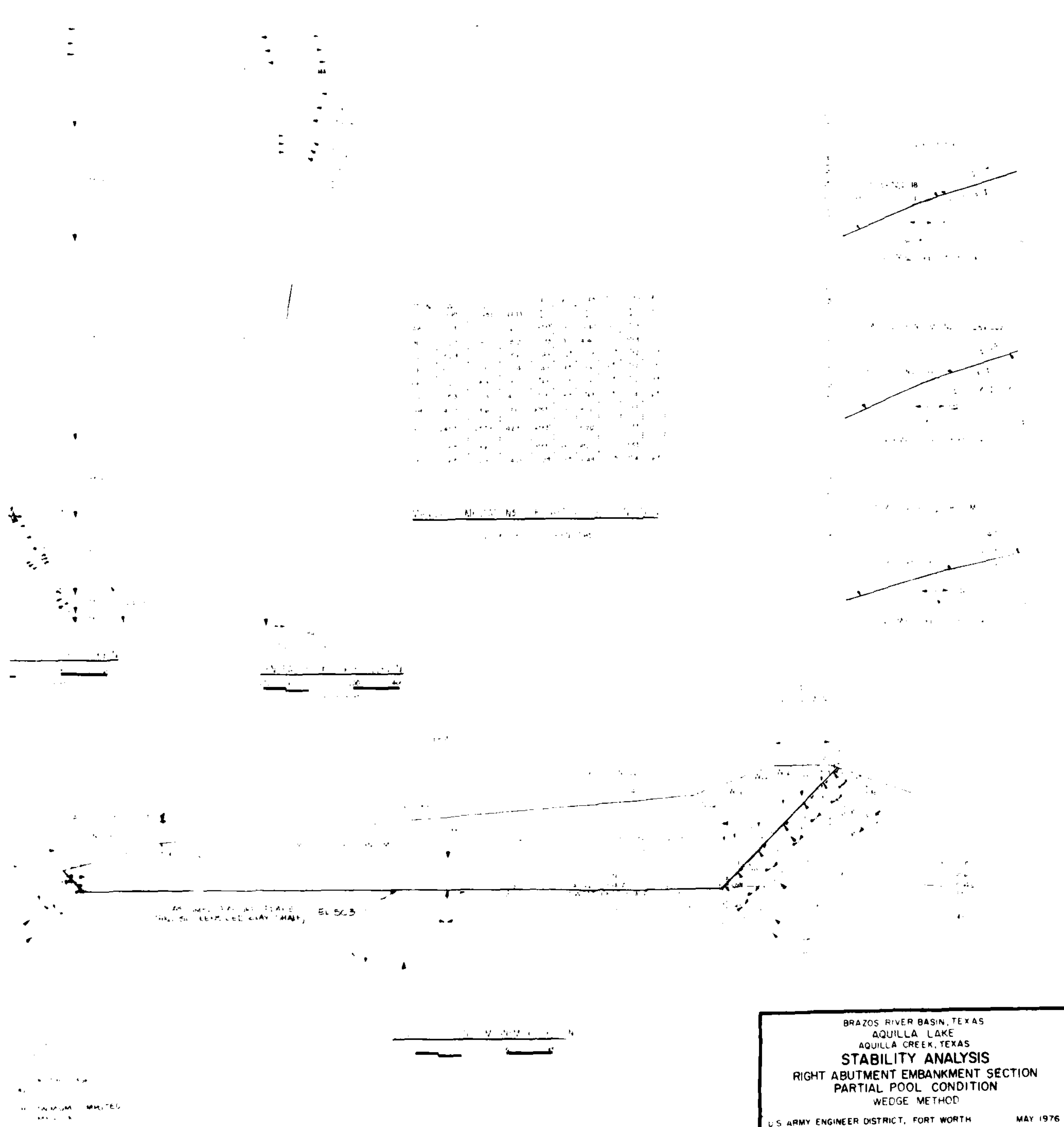
FILE NO — PLATE V-32

PLATE 13

CORPS OF ENGINEERS



U S ARMY



BRAZOS RIVER BASIN, TEXAS
AQUILLA LAKE
AQUILLA CREEK, TEXAS

STABILITY ANALYSIS

RIGHT ABUTMENT EMBANKMENT SECTION
PARTIAL POOL CONDITION
WEDGE METHOD

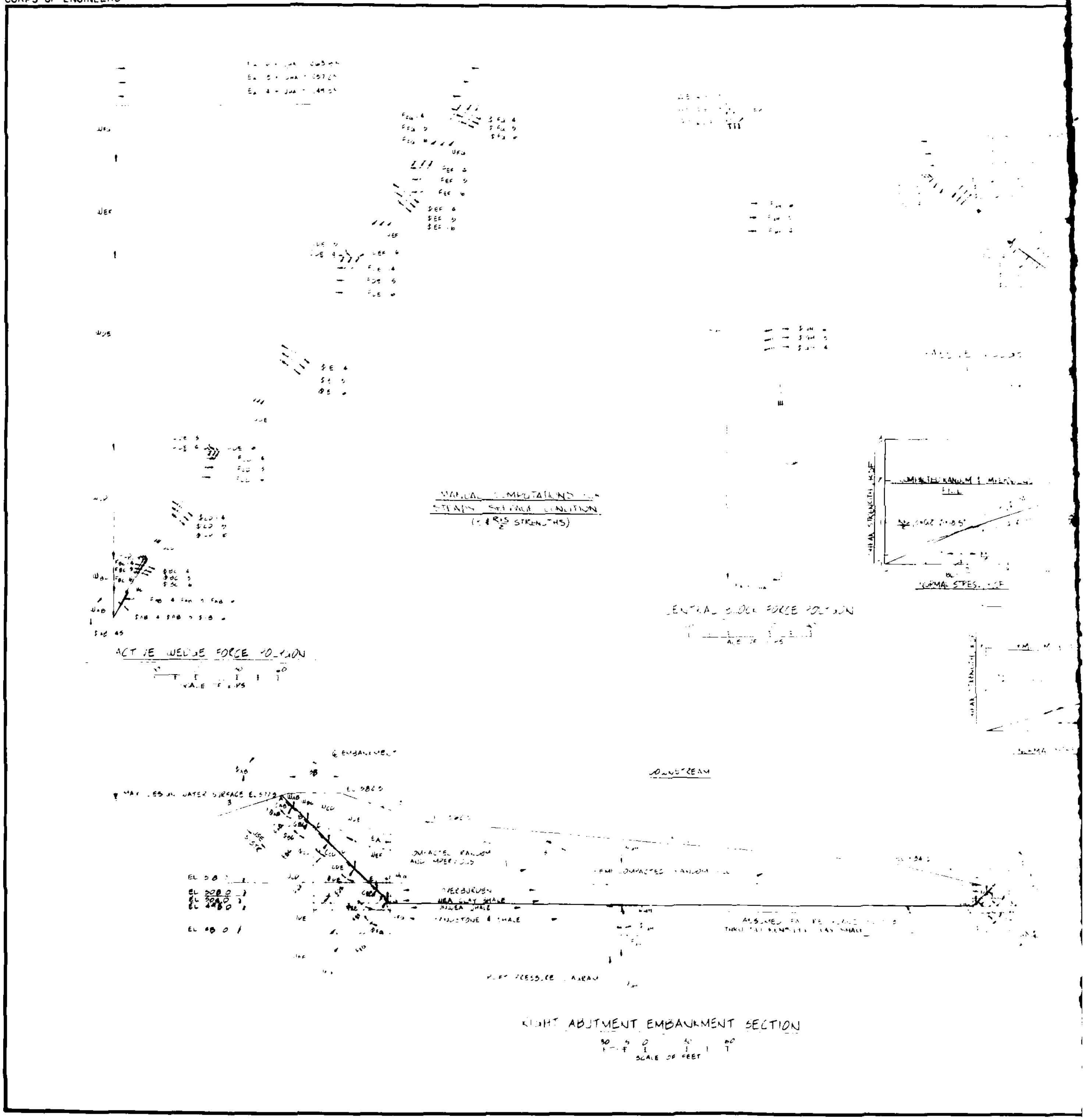
U S ARMY ENGINEER DISTRICT, FORT WORTH MAY 1976

... COMPANY FEATURE DESIGN MEMORANDUM NO. ?

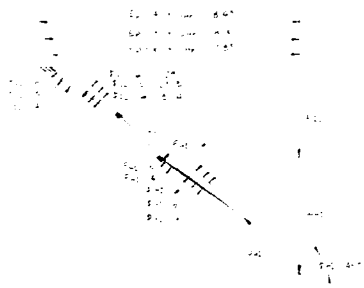
FILE NO PLATE V-33

PLATE 14

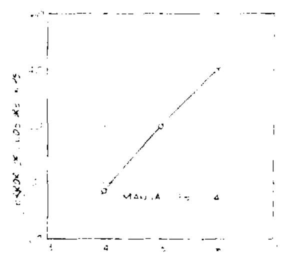
CORPS OF ENGINEERS

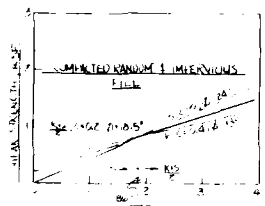


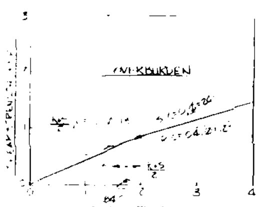
U.S. ARMY

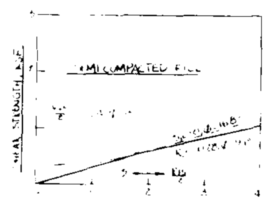


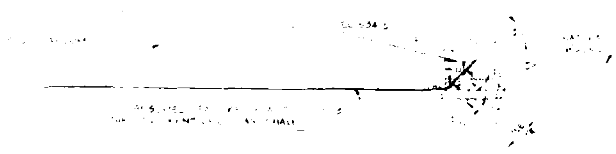
PASSIVE WEDGE FORCE POLYGON











EMBANKMENT SECTION

BRAZOS RIVER BASIN, TEXAS
AQUILLA LAKE
AQUILLA CREEK, TEXAS

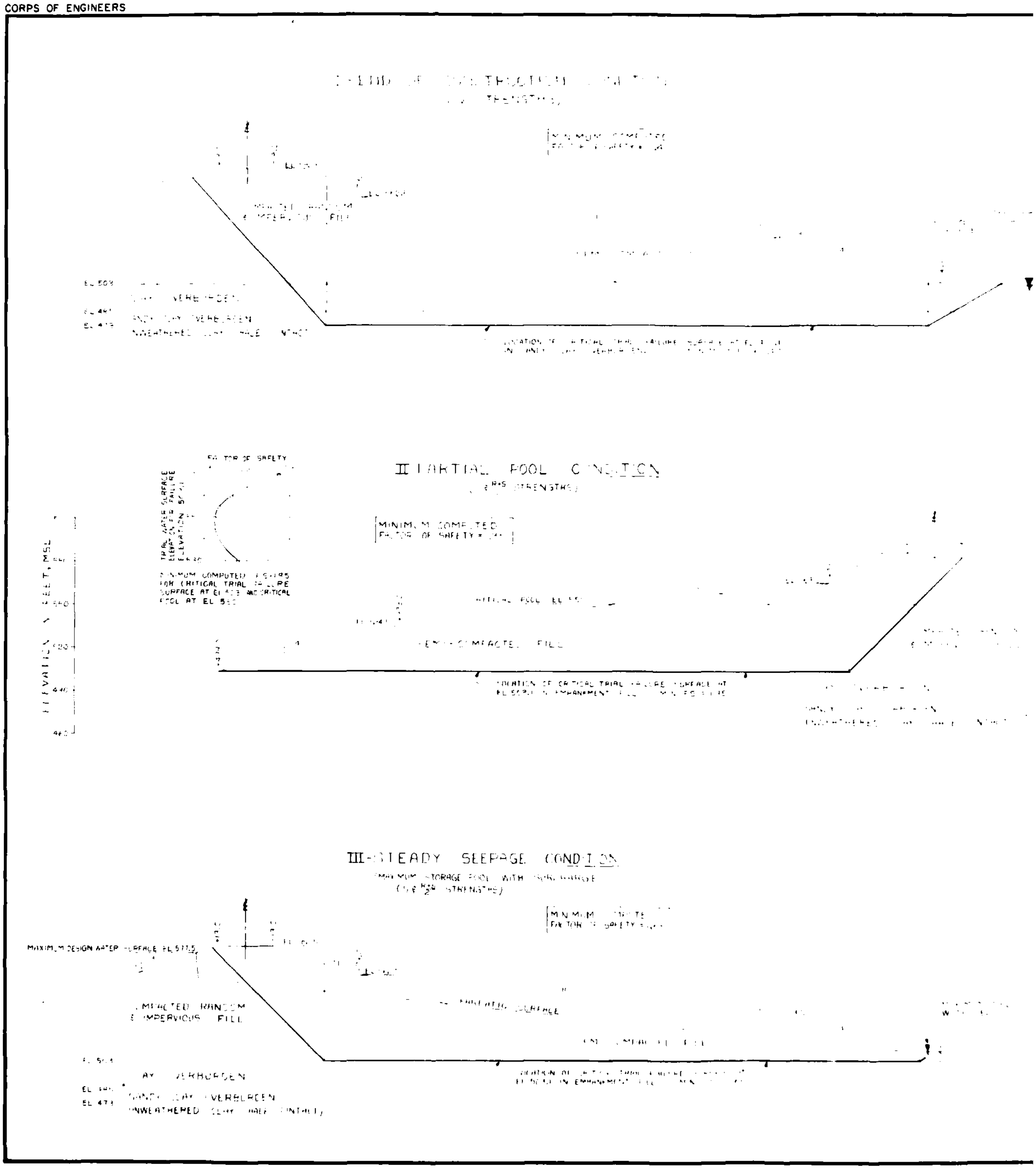
STABILITY ANALYSIS

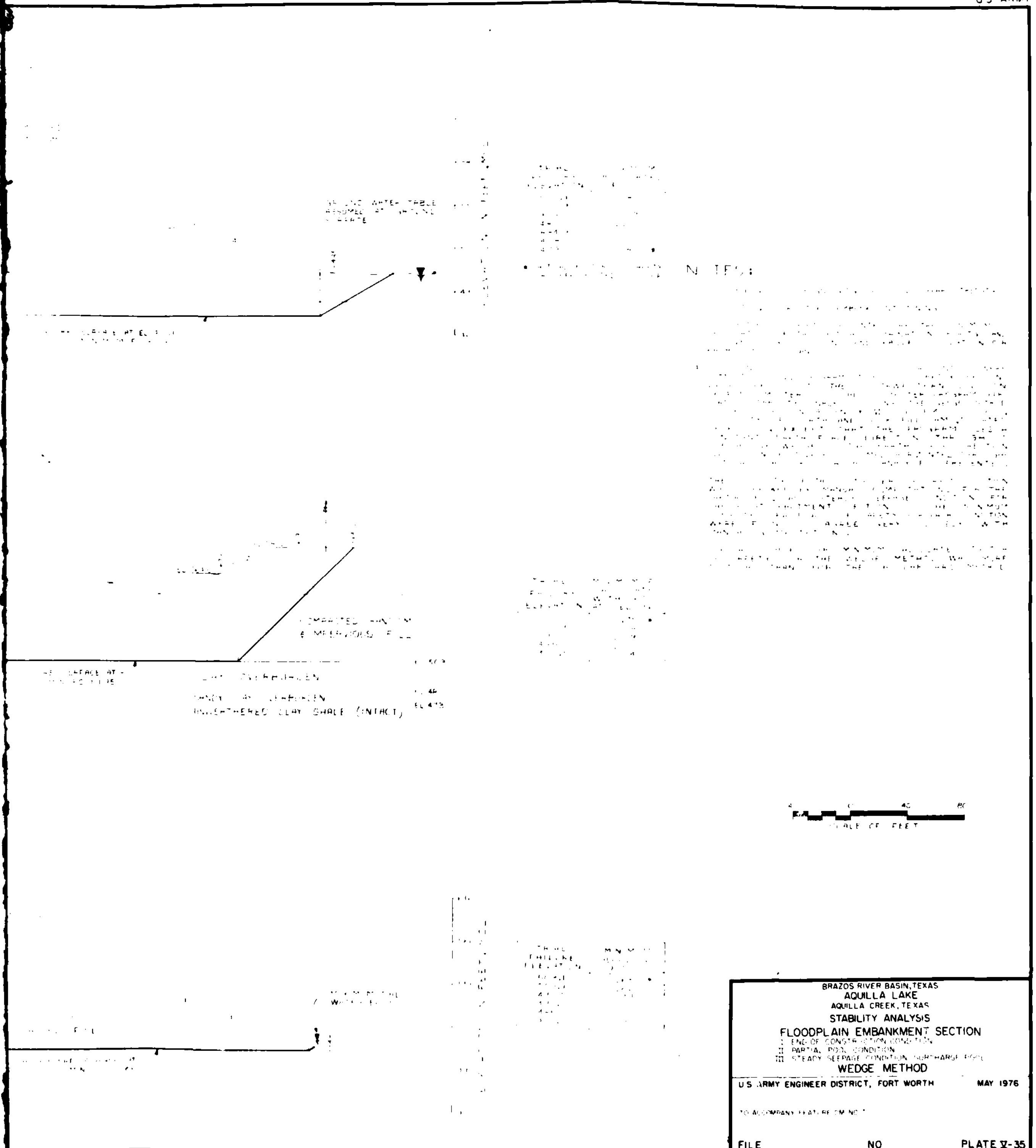
RIGHT ABUTMENT EMBANKMENT SECTION
STEADY SEEPAGE CONDITION
(SURCHARGE POOL - MAXIMUM WATERSURFACE)
WEDGE METHOD

U.S. ARMY ENGINEER DISTRICT, FORT WORTH — MAY 1976

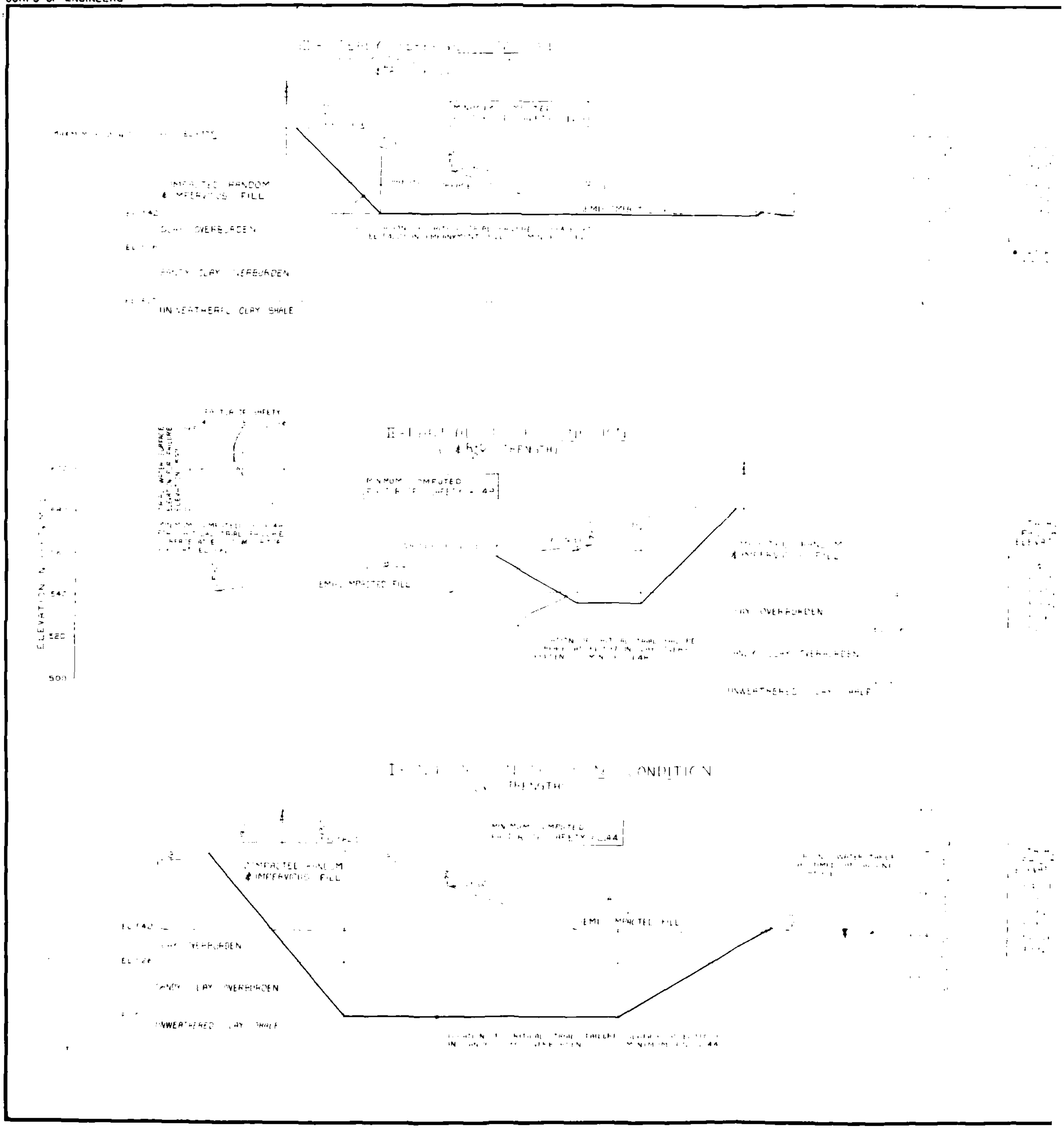
FILE | NO. | PLATE V-34

CORPS OF ENGINEERS

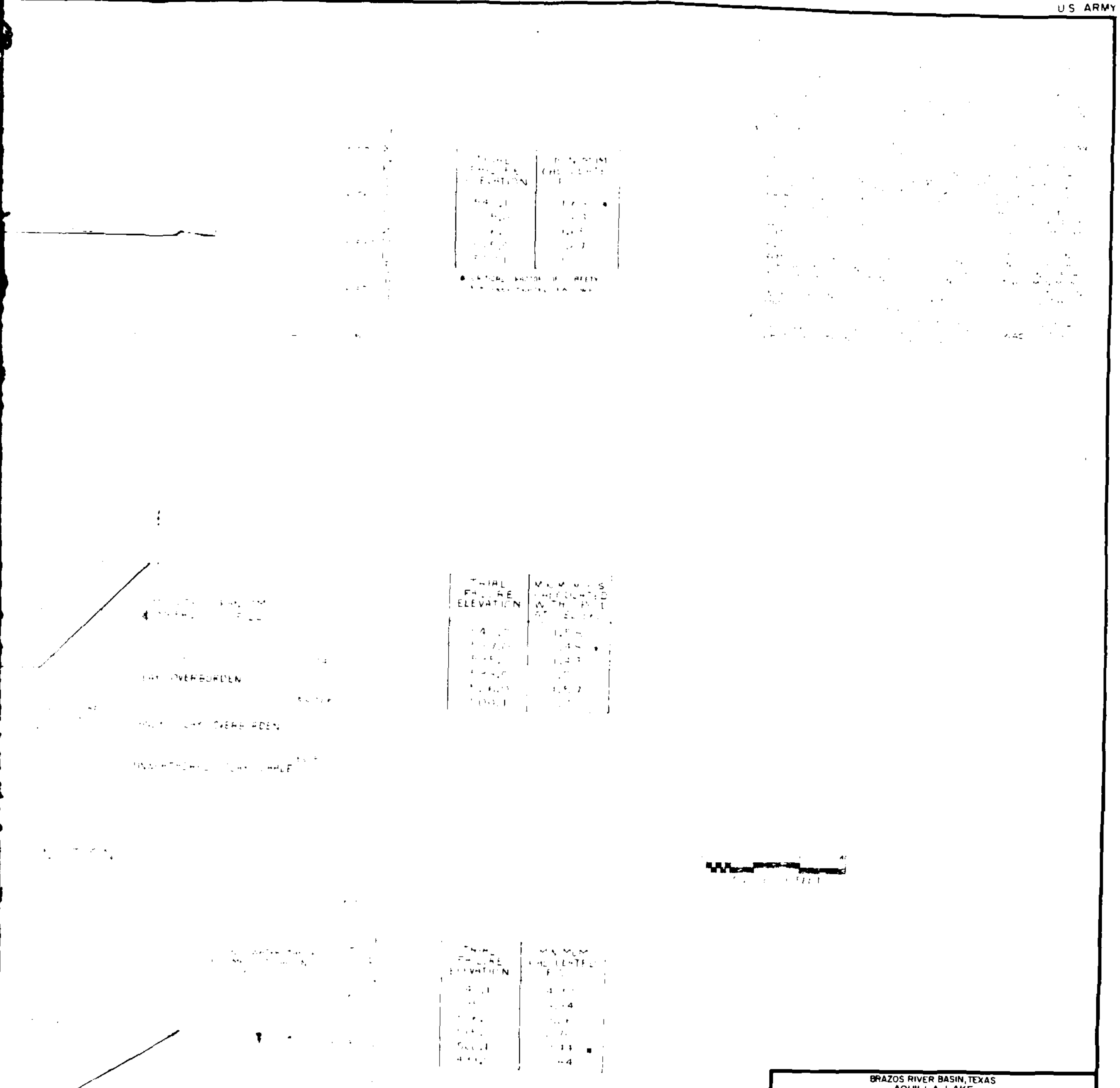



US ARMY
UNWEATHERED CLAY SHALE (INTACT)
BRAZOS RIVER BASIN, TEXAS
AQUILLA LAKE
AQUILLA CREEK, TEXAS
STABILITY ANALYSIS
FLOODPLAIN EMBANKMENT SECTION
WEDGE METHOD
U S ARMY ENGINEER DISTRICT, FORT WORTH
MAY 1976
FILE
NO
PLATE V-35

CORPS OF ENGINEERS



U S ARMY



BRAZOS RIVER BASIN, TEXAS
AQUILLA LAKE
AQUILLA CREEK, TEXAS
STABILITY ANALYSIS
LEFT ABUTMENT EMBANKMENT SECTION
I END OF CONSTRUCTION CONDITION
II PARTIAL POOL CONDITION
III STEADY SEEPAGE CONDITION SURCHARGE POOL
WEDGE METHOD

U S ARMY ENGINEER DISTRICT, FORT WORTH   MAY 1976

TO ACCOMPANY FEATURE DM NO 7

FILE   NO   PLATE V-36

IMPERVIOUS FILL

TABLE 1 OF 1

SAMPLE IDENTIFICATION				CLASSIFICATION			FIELD COMPACTION CONTROL						LABORATORY COMPACTION TESTS			
				SOIL TYPE	ATTERBERG LIMITS		FIELD TESTS		LIQUID LIMIT CORRELATION		MOISTURE CONTENT AND DENSITY		GOV'T PROJECT LAB TESTS		RECORD SAMPLES SWD LAB TESTS	
FIELD NO	STATION	OFFSET	ELEV.		LL	PI	DRY DENS.	WATER CONTENT	MAX DRY DENSITY	OPT WAT CONTENT	2+ or - OF OPT	PERCENT COMPACTION	MAX DRY DENSITY	OPT WAT CONTENT	MAX DRY DENSITY	OPT WAT CONTENT
ID-1	28+00	CL	529.5	CH	64.0	-	88.4	26.2	87.6	26.2	OPT	100.9				
ID-5	30+00	CL	525.8	CH	66.8	40.6	88.6	33.1	85.6	27.9	+5.2	103.5				
ID-10	14+40	CL	526.2	CH	56.8	35.5	96.0	26.3	92.6	24.4	+1.9	103.7	87.0	24.8		
ID-15B	17+00	CL	519.7	CH	66.4	38.3	88.3	29.1	84.3	26.8	+2.3	104.7				
ID-20UA	18+50	25'DS	524.4	CH	56.8	33.5	100.9	24.1	93.6	23.7	+0.4	107.8	92.2	24.9	96.2	22.2
ID-25	21+50	50'DS	533.6	CL	48.6	35.8	102.7	23.7	98.6	21.1	+2.6	104.2				
ID-30UG	16+00	25'US	539.7	CH	60.0	36.8	95.3	27.5	92.3	24.8	+2.7	103.3	93.3	26.0	101.2	21.5
ID-35B	30+50	50'DS	531.6	CH	63.7	-	96.5	24.9	90.9	25.9	+0.8	105.8				
ID-40U	20+50	CL	534.0	CH	50.4	35.5	104.1	22.7	97.4	21.7	+1.0	106.9	97.8	20.8	100.5	21.5
ID-45	13+00	25'DS	540.8	CH	57.9	39.1	102.0	26.4	93.1	26.1	+0.3	109.6				
ID-50C	18+00	25'DS	538.0	CH	63.4	32.6	102.3	26.3	92.1	25.8	+2.1	110.9	94.5	20.0		
ID-55A	11+50	25'US	544.1	CH	59.6	41.7	104.9	25.6	92.9	24.6	+1.0	112.9				
ID-60B	24+00	25'DS	538.0	CH	52.3	31.4	-	24.8	92.1	22.3	+2.5	117.5	88.8	24.9		
ID-65B	15+50	25'DS	543.0	CH	55.6	39.1	99.3	25.4	94.2	23.3	+2.1	110.3				
ID-70	6+50	CL	554.7	CH	59.6	40.3	89.1	31.0	92.4	24.6	+6.4	96.4	93.9	25.0		
ID-75A	19+50	25'US	543.6	CH	59.6	33.2	109.4	24.8	96.7	24.6	+0.2	113.1				
ID-80UC	12+25	CL	550.7	CH	58.2	37.2	98.3	25.8	94.2	23.1	+2.7	104.4	93.6	21.8	98.3	21.6
ID-85	26+50	30'US	544.9	CH	58.2	41.0	96.8	26.0	93.4	23.4	+2.6	103.6				
ID-90U	18+00	CL	549.6	CH	54.7	37.2	103.2	22.0	96.7	22.0	OPT	106.7	98.5	20.5	101.2	20.8
ID-95	12+50	25'DS	555.6	CH	60.9	42.3	95.2	24.8	91.8	24.0	+0.8	103.7				
ID-100UA	27+00	CL	548.1	CH	62.6	42.7	98.3	26.2	91.0	24.5	+1.7	108.0	95.8	22.4	96.8	23.3
ID-105	21+50	25'DS	544.6	CH	74.1	52.3	89.7	31.0	82.5	28.2	+2.8	108.7				
ID-110A	26+50	25'DS	553.4	CH	61.5	41.6	108.8	25.6	92.4	24.2	+1.4	117.7	94.2	23.9		
ID-115	5+50	CL	565.1	CL	49.9	34.1	104.0	21.3	100.1	20.5	+0.8	103.9				
ID-120B	10+50	CL	565.2	CH	55.0	37.3	105.7	25.9	88.1	24.3	+1.6	109.6	97.1	21.0		
ID-125	26+50	CL	565.9	CL	48.3	33.3	107.6	20.3	101.2	19.9	+0.4	106.3				
ID-130	21+50	CL	564.5	CH	57.9	41.4	100.9	23.6	94.3	23.0	+0.6	107.0	100.2	21.1		
ID-135	16+50	CL	566.0	CH	59.7	42.6	100.6	25.2	93.0	23.6	+1.6	107.9				

RANDOM FILL

TABLE 1 OF 2

SAMPLE IDENTIFICATION				CLASSIFICATION			FIELD COMPACTION CONTROL						LABORATORY COMPACTION TESTS			
				SOIL TYPE	ATTERBERG LIMITS		FIELD TESTS		LIQUID LIMIT CORRELATION		MOISTURE CONTENT AND DENSITY		GOV'T PROJECT LAB TESTS		RECORD SAMPLES SWD LAB TESTS	
FIELD No	STATION	OFFSET	ELEV.		LL	PI	DRY DENS.	WATER CONTENT	MAX DRY DENSITY	OPT WAT CONTENT	2+ or - OF OPT	PERCENT COMPACTION	MAX DRY DENSITY	OPT WAT CONTENT	MAX DRY DENSITY	OPT WAT CONTENT
RD-5	24+20	90'US	503.1	CL	48.8	27.8	97.1	23.8	97.8	21.6	+2.2	99.3				
RD-10	26+00	150'US	535.1	CH	54.0	31.8	96.1	25.1	94.2	23.4	+1.7	102.0	91.7	24.7		
RD-15	19+15	150'DS	512.9	CL	36.9	-	112.3	17.1	105.6	17.4	-0.3	106.3				
RD-20	16+50	100'DS	524.2	CL	27.5	-	104.7	18.5	103.0	20.3	-1.8	101.7	101.9	22.2		
RD-25A	11+50	100'US	536.1	CH	50.4	30.9	110.4	19.1	97.4	20.7	-1.6	113.3				
RD-30UA	16+50	175'DS	524.7	CH	66.6	34.6	109.7	19.8	100.0	20.5	-0.7	109.7	99.9	18.7	102.2	20.9
RD-35	18+50	100'DS	525.0	CH	51.6	-	99.2	23.8	96.5	22.4	+1.4	102.8				
RD-40UC	19+50	100'US	529.3	CL	50.6	-	97.9	23.1	97.2	21.7	+1.4	100.7	104.3	19.2	105.2	19.2
RD-45	28+75	81'DS	533.4	CH	59.1	36.4	104.9	27.5	92.6	24.4	+3.1	113.3				
RD-55	25+50	75'US	535.8	CH	50.2	35.3	107.2	20.6	97.5	21.6	-1.0	109.9				
RD-60	22+50	75'US	534.8	CH	49.7	32.6	105.2	21.0	97.8	21.4	-0.4	107.6				
RD-65	23+00	150'US	535.7	CH	53.6	38.7	103.1	22.7	95.6	22.6	+0.1	108.7				
RD-70	29+50	75'US	535.2	CH	56.9	-	100.5	25.4	93.5	23.8	+1.6	107.5				
RD-75	15+00	125'DS	530.8	CH	50.6	31.8	110.6	23.5	97.6	21.5	+2.0	113.3				
RD-80	14+00	150'US	535.5	CH	52.6	38.6	105.6	21.6	95.8	22.4	-0.8	110.2	102.7	17.3		
RD-85	18+00	125'DS	530.1	CL	48.7	34.6	101.5	22.9	98.6	21.2	+1.7	102.9				
RD-90U	15+50	75'DS	534.2	CH	51.8	34.1	100.6	22.5	96.6	22.1	+0.4	104.1	94.1	22.8	102.1	20.5
RD-95	12+00	50'US	542.3	CH	60.6	42.9	98.0	24.6	91.8	24.8	-0.2	106.8				
RD-100	17+00	50'US	538.4	CH	60.1	41.6	98.0	27.6	92.2	24.8	+2.8	106.3	90.3	23.1		
RD-105	22+00	50'US	537.9	CH	56.6	39.4	102.0	24.0	93.7	23.6	+0.4	108.9				
RD-110U	29+50	75'DS	533.6	CH	61.1	42.0	102.5	24.2	91.8	25.1	-0.9	111.7	87.3	23.3	99.4	21.6
RD-115	27+00	50'US	538.0	CH	60.8	42.9	98.9	27.6	91.9	25.0	+2.6	107.6				
RD-120UA	19+50	125'US	537.9	CH	53.9	37.0	101.8	23.1	95.1	22.8	+0.3	107.0	97.7	20.4	101.0	19.6
RD-125	28+00	50'US	538.1	CH	57.8	-	100.4	25.4	93.1	24.0	+1.4	107.8				
RD-130U	17+00	100'DS	539.3	CL	49.8	35.9	103.0	23.3	97.8	21.4	+1.9	105.3	105.1	18.1	102.4	19.2
RD-135	19+00	100'US	534.3	CL	44.0	27.6	107.3	20.3	102.1	19.6	+0.7	105.1				
RD-140	30+00	50'US	537.3	CH	56.5	38.3	101.3	24.3	95.3	22.5	+1.8	106.3	95.7	22.4		
RD-145	25+00	110'US	543.0	CL	49.6	33.6	102.7	22.7	100.0	20.4	+2.3	102.7				
RD-150A	19+50	125'DS	543.2	CH	53.8	40.6	95.3	23.7	93.8	21.8	+1.9	101.6	95.5	22.0		

RANDOM FILL

TABLE 2 OF 2

SAMPLE IDENTIFICATION				CLASSIFICATION			FIELD COMPACTION CONTROL						LABORATORY COMPACTION TESTS			
				SOIL TYPE	ATTERBERG LIMITS		FIELD TESTS		LIQUID LIMIT CORRELATION		MOISTURE CONTENT AND DENSITY		GOV'T PROJECT LAB TESTS		RECORD SAMPLES SWD LAB TESTS	
FIELD NO	STATION	OFFSET	ELEV.		LL	PI	DRY DENS.	WATER CONTENT	MAX DRY DENSITY	OPT WAT CONTENT	2+ or - OF OPT	PERCENT COMPACTION	MAX DRY DENSITY	OPT WAT CONTENT	MAX DRY DENSITY	OPT WAT CONTENT
RD-155A	27+00	100'US	543.5	CH	56.1	-	106.4	22.8	96.2	21.8	+1.0	110.6				
RD-160A	17+00	75'DS	548.2	CH	55.9	39.6	97.0	25.6	94.3	22.4	+3.2	102.9	97.3	22.0		
RD-165A	23+50	125'DS	543.6	CL	52.8	35.1	111.1	23.4	100.2	21.4	+2.0	110.9				
RD-170	12+50	50'DS	558.2	CH	60.8	-	99.1	24.8	92.0	24.0	+0.8	107.7	96.4	23.9		
RD-175	10+50	50'US	557.0	CH	50.7	34.3	99.1	22.4	99.6	20.8	+1.6	99.5				
RD-180U	26+00	75'US	548.0	CL	35.8	22.4	111.9	18.6	110.6	16.0	+2.6	101.2	99.5	18.8	102.5	20.0
RD-185	25+00	75'DS	547.8	CH	54.9	-	108.3	21.0	96.5	22.1	-1.1	112.2				
RD-190	21+50	50'US	553.0	CH	54.5	37.5	99.1	21.9	96.8	22.0	-0.1	102.4	100.8	20.4		
RD-195	12+00	25'US	559.8	CH	58.6	21.0	107.0	21.6	93.7	23.3	-1.7	114.2				
RD-200	7+00	25'US	559.0	CH	56.6	39.5	107.4	21.9	95.2	22.6	-0.7	112.8	102.2	19.8		
RD-205A	27+00	75'DS	548.0	CH	50.3	34.0	114.7	20.8	99.8	21.2	-0.4	114.9				
RD-210	24+50	50'US	553.7	CH	58.1	40.1	100.3	25.0	94.1	23.1	+1.9	106.6	92.2	21.2		
RD-215	25+50	50'US	554.1	CH	59.3	40.9	97.5	26.6	93.3	23.5	+3.1	104.5				
RD-220U	21+50	50'DS	559.0	CH	62.3	45.9	102.4	23.6	91.1	24.4	-0.8	112.4	97.9	20.4	98.9	21.2
RD-225	23+00	25'US	559.0	CH	53.5	37.1	104.8	22.8	97.5	21.6	+1.2	107.5				
RD-230	27+00	25'US	562.0	CH	54.3	36.1	100.0	21.1	97.0	21.9	-0.8	103.1	101.9	20.8		

SEMI-COMPACTED FILL

SAMPLE IDENTIFICATION				CLASSIFICATION			FIELD COMPACTION CONTROL			
				SOIL TYPE	ATTERBERG LIMITS		FIELD TESTS		LIQUID LIMIT CORRELATION	
FIELD NO	STATION	OFFSET	ELEV.		LL	PI	DRY DENS.	WATER CONTENT	MAX DRY DENSITY	OPT WAT CONTENT
SFD-[illegible]	17+00	[illegible]	[illegible]	CL	29.4	13.6	113.4	[illegible]	[illegible]	[illegible]
SFD-[illegible]	17+00	[illegible]	[illegible]	CL	49.0	37.6	106.1	20.7	94.6	[illegible]
SFD-1[illegible]A	12+00	[illegible]	[illegible]	CH	53.2	34.5	106.9	25.1	94.8	[illegible]
SFD-[illegible]	24+00	[illegible]	[illegible]	CL	42.0	26.6	106.0	[illegible]	[illegible]	[illegible]
SFD-[illegible]	25+00	[illegible]	[illegible]	CL	30.5	14.4	115.2	15.0	[illegible]	[illegible]
SFD-[illegible]	31+00	[illegible]	[illegible]	CL	44.2	25.6	108.[illegible]	19.6	[illegible]	[illegible]
SFD-[illegible]	23+00	[illegible]	[illegible]	SC	[illegible]	13.8	117.3	[illegible]	[illegible]	[illegible]
SFD-[illegible]	[illegible]	[illegible]	[illegible]	SC	[illegible]	[illegible]	125.1	[illegible]	[illegible]	[illegible]
SFD-[illegible]	[illegible]	[illegible]	[illegible]	SC	[illegible]	13.1	[illegible]	13.6	[illegible]	[illegible]
SFD-[illegible]	17+[illegible]	[illegible]	[illegible]	SC	31.[illegible]	[illegible]	112.[illegible]	[illegible]	[illegible]	[illegible]
SFD-[illegible]A	[illegible]	[illegible]	[illegible]	SC	[illegible]	-	122.4	[illegible]	[illegible]	[illegible]
SFD-[illegible]	23+00	[illegible]	[illegible]	CL	36.5	20.4	107.3	20.9	[illegible]	[illegible]
SFD-[illegible]	19+[illegible]	[illegible]	[illegible]	SC	37.1	[illegible]	126.1	17.6	[illegible]	[illegible]
SFD-[illegible]	[illegible]	[illegible]	[illegible]	CL	32.9	[illegible]	117.1	[illegible]	[illegible]	[illegible]
SFD-[illegible]	[illegible]	[illegible]	[illegible]	SC	23.2	11.9	124.8	12.3	127.7	13.2
SFD-[illegible]	17+[illegible]	[illegible]	[illegible]	CH	56.6	39.4	103.1	22.5	93.2	[illegible]
SFD-[illegible]	[illegible]	[illegible]	[illegible]	SC	30.7	17.3	120.9	[illegible]	[illegible]	[illegible]
SFD-[illegible]A	[illegible]	[illegible]	[illegible]	CL	29.7	-	[illegible]	12.9	[illegible]	[illegible]
SFD-[illegible]A	[illegible]	[illegible]	38.[illegible]	CL	35.3	21.7	120.[illegible]	15.8	109.6	16.9
SFD-[illegible]	[illegible]	[illegible]	[illegible]	CL	51.5	37.9	112.5	23.0	[illegible]	[illegible]
SFD-[illegible]A	[illegible]	[illegible]	[illegible]	CH	50.6	-	107.6	20.5	[illegible]	[illegible]
SFD-[illegible]	[illegible]	[illegible]	[illegible]	CH	66.6	[illegible]	[illegible]	18.9	[illegible]	[illegible]
SFD-115	[illegible]	[illegible]	[illegible]	CH	51.[illegible]	35.4	107.9	20.9	96.7	[illegible]
SFD-[illegible]	[illegible]	[illegible]	[illegible]	CL	[illegible]	-	100.[illegible]	[illegible]	99.6	[illegible]
SFD-[illegible]	[illegible]	[illegible]	[illegible]	CH	53.6	36.3	107.9	20.[illegible]	[illegible]	[illegible]
SFD-130	[illegible]	[illegible]	[illegible]	CL	37.8	[illegible]	115.[illegible]	[illegible]	[illegible]	[illegible]
SFD-[illegible]	[illegible]	[illegible]	[illegible]	CH	53.[illegible]	40.[illegible]	108.0	[illegible]	[illegible]	[illegible]
SFD-[illegible]	[illegible]	[illegible]	[illegible]	CH	[illegible]	[illegible]	108.1	20.5	[illegible]	[illegible]
SFD-[illegible]	[illegible]	[illegible]	[illegible]	CL	[illegible]	[illegible]	111.[illegible]	19.3	[illegible]	[illegible]

SEMI-COMPACTED FILL

SAMPLE IDENTIFICATION				CLASSIFICATION			FIELD COMPACTION CONTROL			
				SOIL TYPE	ATTERBERG LIMITS		FIELD TESTS		LIQUID LIMIT CORRELATION	
FIELD NO	STATION	OFFSET	ELEV.		LL	PI	DRY DENS.	WATER CONTENT	MAX DRY DENSITY	OPT WAT CONTENT
SFD-[illegible]A	[illegible]	[illegible]	[illegible]	CL	41.9	31.8	106.7	17.9	99.3	[illegible]
SFD-[illegible]	[illegible]	[illegible]	[illegible]	CL	46.5	30.1	107.0	18.9	100.3	[illegible]
SFD-[illegible]	[illegible]	[illegible]	[illegible]	CL	[illegible]	26.5	116.3	16.4	[illegible]	[illegible]
SFD-[illegible]	21+50	[illegible]	[illegible]	CL	41.0	27.9	109.4	20.6	[illegible]	[illegible]
SFD-[illegible]	[illegible]	100'[illegible]	33.3	CL	36.1	23.9	113.2	17.1	108.0	[illegible]
SFD-[illegible]	[illegible]	[illegible]	[illegible]	CL	40.8	27.2	117.0	17.4	[illegible]	[illegible]
SFD-[illegible]	[illegible]	[illegible]	[illegible]	CL	41.0	27.3	115.3	16.7	[illegible]	[illegible]
SFD-[illegible]	[illegible]	[illegible]	[illegible]	CL	46.5	31.5	108.5	21.4	102.4	[illegible]
SFD-[illegible]	13+00	[illegible]	[illegible]	CL	39.4	24.6	116.5	16.3	[illegible]	[illegible]
SFD-[illegible]	[illegible]	[illegible]	[illegible]	CL	34.6	23.2	113.6	17.4	111.6	[illegible]
SFD-[illegible]	[illegible]	[illegible]	[illegible]	CL	44.8	29.2	111.8	19.0	[illegible]	[illegible]
SFD-[illegible]	[illegible]	[illegible]	38.[illegible]	CH	54.3	37.1	106.3	22.5	96.9	[illegible]
SFD-[illegible]	[illegible]	[illegible]	[illegible]	CL	45.0	32.5	110.1	19.9	[illegible]	[illegible]
SFD-[illegible]	[illegible]	[illegible]	39.7	CL	47.8	-	109.8	19.8	101.6	[illegible]
SFD-[illegible]	[illegible]	[illegible]	38.3	CL	42.6	31.1	112.4	19.2	[illegible]	[illegible]
SFD-[illegible]	[illegible]	[illegible]	32.8	CL	41.4	28.7	112.5	17.9	106.[illegible]	[illegible]
SFD-[illegible]30A	9+50	[illegible]	[illegible]8.0	CL	34.2	-	116.9	14.5	104.3	[illegible]
SFD-[illegible]	[illegible]	[illegible]	38.2	CL	38.7	26.1	115.5	15.0	108.2	[illegible]
SFD-[illegible]	10+50	[illegible]	[illegible]	CL	49.7	35.7	113.2	18.3	100.[illegible]	[illegible]
SFD-[illegible]	17+00	[illegible]	[illegible]	CL	46.0	-	105.1	22.1	103.[illegible]	[illegible]
SFD-[illegible]	8+00	125'US	533.7	CH	62.7	42.2	102.6	22.2	89.9	[illegible]
SFD-[illegible]	21+00	[illegible]'US	543.8	CH	[illegible]	-	105.6	22.0	96.8	21.9
SFD-260	30+50	[illegible]'US	537.2	CH	57.0	39.0	106.0	20.7	94.8	22.8
SFD-[illegible]	[illegible]	[illegible]'DS	534.5	CL	49.6	-	108.4	21.5	100.3	[illegible]
SFD-270U	15+50	150'DS	[illegible]8.0	CL	45.8	30.7	111.5	19.9	103.9	[illegible]
SFD-[illegible]A	[illegible]	150'[illegible]	[illegible].6	CH	57.6	-	10[illegible]	27.1	94.4	22.9
SFD-280	30+50	[illegible]	[illegible]9.3	CH	60.8	43.3	10[illegible]	21.0	91.8	24.0
SFD-[illegible]	16+00	[illegible]	[illegible]	CH	57.0	39.4	104.4	23.1	104.4	23.1
SFD-290	15+50	[illegible]	[illegible]	CH	51.3	35.4	105.1	22.9	99.1	[illegible]

SEMI-COMPACTED FILL

SAMPLE IDENTIFICATION				CLASSIFICATION			FIELD COMPACTION CONTROL				
				SOIL TYPE	ATTERBERG LIMITS		FIELD TESTS		LIQUID LIMIT CORRELATION		MOISTURE CONTENT AND DENSITY
FIELD NO	STATION	OFFSET	ELEV.		LL	PI	DRY DENS.	WATER CONTENT	MAX DRY DENSITY	OPT WAT CONTENT	2+ or - OF OPT
SFD-[illegible]	26+00	[illegible]	[illegible]	CH	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	-1.9
SFD-300[illegible]	29+50	[illegible]	[illegible]	CH	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	+1.[illegible]
SFD-305	18+00	125'[illegible]	[illegible]	CL	35.8	-	111.9	16.5	[illegible]	16.0	[illegible]
SFD-310B	15+50	[illegible]	550.1	CL	46.1	33.0	[illegible]	17.7	[illegible]	19.3	-1.[illegible]
SFD-315	[illegible]	[illegible]	[illegible]	CH	66.8	47.1	98.5	26.3	86.4	26.5	[illegible]
SFD-320	25+50	[illegible]	549.1	CL	[illegible]	-	[illegible]	[illegible]	107.1	[illegible]	-3.[illegible]
SFD-325	29+00	350'[illegible]	539.9	CL	31.0	17.3	[illegible]	[illegible]	[illegible]	[illegible]	-2.1
SFD-330	28+00	125'[illegible]	556.1	CL	48.0	[illegible]	107.6	20.7	101.4	19.9	+0.8
SFD-335A	33+70	20[illegible]'US	536.0	CH	66.0	17.2	103.6	[illegible]	88.1	[illegible]	[illegible]

SEMI-COMPACTED FILL

TABLE 1 OF 3

Field No.	Offset	Elev.	Type	LL	PI	Dry Dens.	Water Content	Max Dry Density	Opt Wat Content	± of Opt	Percent Compaction	Gov't Max Dry Density	Gov't Opt Wat Content	Record Max Dry Density	Record Opt Wat Content
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	15.8	[illegible]	102.5				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	95.6	21.7	-1.0	108.4	103.7	16.7		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	94.8	23.1	+7.0	104.4				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	24.3	[illegible]	103.6	96.8	20.4		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	110.0	15.2	+0.2	104.7				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	100.8	20.0	[illegible]	107.3	[illegible]	18.8		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	103.0				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.6	107.6	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	13.2	OPT	111.1				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	15.6	+1.1	[illegible]	[illegible]	14.3		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	16.1	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19.6	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	108.6	16.9	-1.1	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		

SEMI-COMPACTED FILL

TABLE 2 OF 3

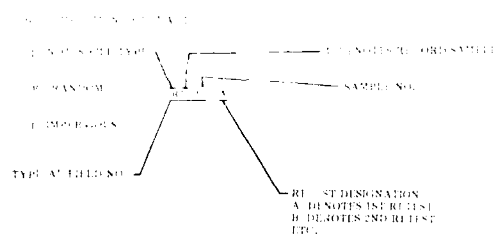
Field No.	Offset	Elev.	Type	LL	PI	Dry Dens.	Water Content	Max Dry Density	Opt Wat Content	± of Opt	Percent Compaction	Gov't Max Dry Density	Gov't Opt Wat Content	Record Max Dry Density	Record Opt Wat Content
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	17.9	[illegible]	18.9	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	100.3	20.4	-1.5	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	16.4	[illegible]	19.0	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	15.7	+1.9	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	108.0	17.1	OPT	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	18.6	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	18.6	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19.5	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	17.2	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	111.6	15.6	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	103.9	19.9	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	37.1	[illegible]	[illegible]	96.9	21.9	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19.9	103.7	18.9	+1.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	101.6	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	18.1	+1.1	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	17.7	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	15.5	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	108.2	16.9	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	CL	[illegible]	[illegible]	[illegible]	18.3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	CL	[illegible]	-	[illegible]	[illegible]	103.0	19.3	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	CH	[illegible]	[illegible]	[illegible]	[illegible]	89.9	[illegible]	[illegible]	114.1	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	105.6	[illegible]	96.8	[illegible]	+0.1	109.1				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	94.8	22.8	[illegible]	111.8	97.8	[illegible]		
[illegible]	[illegible]	[illegible]	CL	[illegible]	-	[illegible]	[illegible]	[illegible]	20.4	+1.1	[illegible]				
[illegible]	[illegible]	[illegible]	CL	[illegible]	30.7	[illegible]	19.9	[illegible]	19.2	+0.7	108.3	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	CH	57.6	-	[illegible]	27.1	94.4	22.9	[illegible]	106.5				
[illegible]	[illegible]	[illegible]	CH	[illegible]	[illegible]	[illegible]	21.0	91.8	24.0	-3.0	113.5				
[illegible]	[illegible]	[illegible]	CH	[illegible]	[illegible]	[illegible]	[illegible]	104.4	[illegible]	OPT	110.0				
[illegible]	[illegible]	[illegible]	CH	[illegible]	[illegible]	[illegible]	[illegible]	99.1	20.9	[illegible]	106.1	109.4	[illegible]		

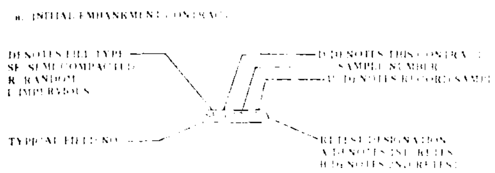
SEMI-COMPACTED FILL

TABLE 3 OF 3

Field No.	Offset	Elev.	Type	LL	PI	Dry Dens.	Water Content	Max Dry Density	Opt Wat Content	± of Opt	Percent Compaction	Gov't Max Dry Density	Gov't Opt Wat Content	Record Max Dry Density	Record Opt Wat Content
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-1.9	103.8				
[illegible]	[illegible]	[illegible]	CH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	+1.7	100.1				
[illegible]	[illegible]	[illegible]	CL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	+0.5	101.6				
[illegible]	[illegible]	[illegible]	CL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19.3	1.6	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	114.0				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	106.5	112.3	17.4		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	108.8				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	105.7	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				

NOTES ON COMPACTION CONTROL [illegible] NUMBER





U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY: [illegible]
DRAWN BY: [illegible]
REVIEWED BY: [illegible]
SUBMITTED BY: [illegible]

[illegible] LAKE
[illegible]
SEMI-COMPACTED [illegible]
[illegible]

INV NO | DATED
CONTR NO
DRAWING NUMBER | SHEET NO | SEQUENCE NO

IMPERVIOUS FILL

TABLE 1 OF 3

SAMPLE IDENTIFICATION				CLASSIFICATION			FIELD COMPACTION CONTROL						LABORATORY COMPACTION TESTS			
				SOIL TYPE	ATTERBERG LIMITS		FIELD TESTS		LIQUID LIMIT CORRELATION		MOISTURE CONTENT AND DENSITY		GOV'T PROJECT LAB TESTS		RECORD SAMPLES SWD LAB TESTS	
FIELD NO	STATION	OFFSET	ELEV.		LL	PI	DRY DENS.	WATER CONTENT	MAX DRY DENSITY	OPT WAT CONTENT	%+ or - OF OPT	PERCENT COMPACTION	MAX DRY DENSITY	OPT WAT CONTENT	MAX DRY DENSITY	OPT WAT CONTENT
I-5	55+50	CL	[illegible]	CH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	+3.0	102.9				
I-10	89+00	CL	[illegible]	CH	[illegible]	[illegible]	[illegible]	[illegible]	95.5	22.5	+2.7	[illegible]	[illegible]	[illegible]		
I-15	[illegible]	CL	[illegible]	CH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
I-20	66+55	CL	[illegible]	CH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	114.6	[illegible]	[illegible]		
I-25	94+00	CL	[illegible]	CH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	23.1	+3.9	[illegible]				
I-30	61+75	CL	[illegible]	CH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	22.6	+1.1	[illegible]	[illegible]	[illegible]		
I-35	91+50	CL	[illegible]	CH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	26.0	+0.8	110.3				
I-40A	80+00	CL	[illegible]	CH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	+0.4	113.4	[illegible]	[illegible]		
I-45	[illegible]	CL	[illegible]	CH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	25.3	+1.3	[illegible]				
I-50	100+50	CL	[illegible]	CH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	24.8	+1.3	[illegible]	[illegible]	[illegible]		
I-55	83+00	CL	[illegible]	CH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
I-60	62+00	CL	[illegible]	CH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	25.2	[illegible]	[illegible]	96.7	22.8		
I-65	60+00	CL	[illegible]	CH	[illegible]	[illegible]	[illegible]	26.0	[illegible]	25.0	[illegible]	[illegible]				
I-70	57+50	CL	533.4	CH	89.9	64.0	[illegible]	25.0	90.6	24.9	+0.6	104.2				
I-75	66+50	CL	534.0	CH	62.4	44.9	[illegible]	26.6	92.0	24.3	+2.3	102.6				
I-80	51+50	CL	538.3	CH	62.0	45.0	99.8	24.6	92.2	24.2	+0.4	108.2	[illegible]	[illegible]		
I-85	55+00	CL	521.2	CH	61.0	42.2	[illegible]	24.8	92.8	23.9	+0.9	102.8				
I-90	89+00	CL	538.4	CH	64.3	46.4	97.6	24.4	90.5	24.8	[illegible]	[illegible]	91.8	[illegible]		
I-95	69+50	CL	534.6	CH	62.7	44.2	[illegible]	[illegible]	-	24.4	+0.7	[illegible]				
I-100	58+00	CL	516.4	CH	58.0	40.0	[illegible]	26.1	94.6	23.1	+3.0	101.8	[illegible]	23.6		
I-105	[illegible]	CL	545.0	CH	60.1	41.6	95.7	27.9	93.3	23.7	[illegible]	102.6				
I-110	85+50	[illegible]	540.2	CH	59.4	42.1	[illegible]	26.1	93.8	23.5	+2.6	103.6	91.5	[illegible]		
[illegible]	90+00	CL	541.6	CH	53.5	[illegible]	[illegible]	[illegible]	97.4	21.8	[illegible]	106.7				
IU-120A	86+00	CL	544.2	CH	57.5	41.2	100.4	24.7	95.0	23.0	+1.7	[illegible]	89.6	21.6	[illegible]	[illegible]
I-125	86+00	15'US	545.2	CH	52.9	35.8	100.4	24.1	97.8	21.6	+2.5	102.7				
I-130A	[illegible]	CL	536.6	CH	53.5	36.8	100.2	22.4	97.4	21.8	+0.6	102.9	98.3	22.3		
I-135	[illegible]	20'US	543.4	CH	53.6	37.2	97.7	25.2	97.4	21.8	+3.4	100.3				
IU-140A	76+00	CL	545.2	CH	62.3	44.1	97.6	24.7	91.0	23.3	-0.6	106.2	93.1	23.6	[illegible]	[illegible]
[illegible]	[illegible]	CL	555.3	CH	54.4	39.0	[illegible]	23.8	99.6	22.2	-0.4	[illegible]				

IMPERVIOUS FILL

TABLE 2 OF 3

SAMPLE IDENTIFICATION				CLASSIFICATION			FIELD COMPACTION CONTROL						LABORATORY COMPACTION TESTS			
				SOIL TYPE	ATTERBERG LIMITS		FIELD TESTS		LIQUID LIMIT CORRELATION		MOISTURE CONTENT AND DENSITY		GOV'T PROJECT LAB TESTS		RECORD SAMPLES SWD LAB TESTS	
FIELD NO	STATION	OFFSET	ELEV.		LL	PI	DRY DENS.	WATER CONTENT	MAX DRY DENSITY	OPT WAT CONTENT	%+ or - OF OPT	PERCENT COMPACTION	MAX DRY DENSITY	OPT WAT CONTENT	MAX DRY DENSITY	OPT WAT CONTENT
[illegible]	72+00	CL	544.3	CH	61.2	39.7	93.9	25.1	82.0	24.0	+1.1	[illegible]	[illegible]	[illegible]		
I-155	68+00	CL	544.3	CH	57.8	42.0	[illegible]	24.7		23.0	+1.7	107.6				
[illegible]	66+00	CL	545.0	CH	[illegible]	[illegible]	[illegible]	27.9	84.6	27.8	+0.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
I-165	81+00	CL	555.1	CH	64.4	46.3	99.3	24.6	90.7	24.9	-0.3	[illegible]				
I-170	55+00	30'US	511.1	CH	64.9	46.0	101.9	24.7	[illegible]	25.0	[illegible]	[illegible]	[illegible]	[illegible]		
I-175	75+00	CL	555.0	CH	71.8	51.3	[illegible]	[illegible]	86.1	27.0	[illegible]	[illegible]				
I-180	43+50	CL	495.3	CH	75.3	55.9	95.8	27.8	84.0	[illegible]	-0.2	[illegible]	[illegible]	[illegible]		
I-185A	45+50	CL	[illegible]	CH	73.0	53.1	94.6	29.8	85.5	27.3	[illegible]	113.7				
I-190	39+00	CL	536.0	CH	72.9	54.1	[illegible]	[illegible]	85.5	27.3	[illegible]	[illegible]	[illegible]	[illegible]		
I-195	41+70	30'DS	506.6	CH	75.6	56.3	97.1	28.1	[illegible]	[illegible]	+0.1	[illegible]				
I-200	37+00	CL	530.5	CH	68.4	48.4	95.4	28.2	[illegible]	26.0	+2.2	[illegible]	[illegible]	[illegible]		
I-205	33+50	CL	529.2	CH	73.3	52.9	101.8	27.9	85.2	27.4	+0.5	[illegible]				
I-210	41+00	CL	519.0	CH	77.4	55.9	96.9	27.8	82.8	28.5	-0.3	[illegible]	[illegible]	[illegible]		
I-215	36+50	CL	521.7	CH	72.2	51.1	97.6	27.3	85.9	27.1	+0.2	113.4				
I-220	60+00	CL	545.0	CH	76.5	55.7	[illegible]	30.5	83.3	28.3	+2.2	[illegible]	[illegible]	[illegible]		
I-225	45+00	50'US	509.3	CH	89.4	75.4	[illegible]	29.3	84.0	28.0	+1.3	[illegible]				
I-230	43+00	CL	516.1	CH	72.8	52.0	92.7	29.8	85.6	28.8	+1.0	[illegible]	[illegible]	[illegible]		
I-235	42+00	50'US	520.9	CH	69.7	49.0	[illegible]	29.2	82.4	[illegible]	+2.8	[illegible]				
I-240	63+00	CL	554.0	CH	74.6	53.7	[illegible]	30.3	84.4	27.8	+2.5	[illegible]	[illegible]	[illegible]		
I-245	68+00	15'US	556.2	CH	73.8	54.5	93.8	28.0	84.9	27.5	+0.5	110.5				
I-250A	35+00	CL	533.9	CH	73.1	52.7	90.0	28.3	83.7	27.3	+1.0	107.5	87.8	28.9		
I-255	41+00	CL	534.0	CH	62.7	44.8	101.6	24.5	91.7	24.4	+0.1	110.8				
I-260	78+15	CL	559.4	CH	55.9	38.1	111.9	25.4	95.9	22.5	+2.9	116.7	96.0	23.0		
I-265	34+00	CL	544.9	CH	50.2	34.7	101.6	22.5	99.4	20.8	+1.7	[illegible]				
IU-270	36+00	CL	544.9	CL	49.1	32.9	[illegible]	20.8	100.8	20.2	+0.6	105.4	100.4	21.2	[illegible]	[illegible]
I-275	33+00	CL	555.0	CH	52.3	36.8	106.0	21.0	97.6	21.4	-0.4	108.6				
I-280	76+00	CL	564.0	CH	61.9	42.9	99.8	25.6	92.2	24.2	+1.4	108.2	97.9	21.1		
I-285	54+00	CL	505.8	CH	60.5	44.9	89.8	29.0	93.1	23.8	+0.3	96.6				
I-290	51+00	CL	500.4	CH	59.1	40.2	97.6	[illegible]	[illegible]	23.4	+1.8	101.9	90.7	27.8		

DENOTES FILL TYPE

R RANDOM

I IMPERVIOUS

TYPICAL FIELD NO.

IMPERVIOUS FILL

TABLE 7 OF 3

FIELD NO.	STATION	OFFSET	ELEV.	SOIL TYPE	LL	PI	DRY DEN	WATER CONTENT	MAX DRY DEN	OPT WATER CONTENT	DEV FROM OPT W.C.	[illegible]	MAX DRY DENSITY	WATER CONTENT	MAX DRY DENSITY	WATER CONTENT
I-29[illegible]	50+00	50'DS	[illegible]	CH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	+[illegible]	[illegible]				
I-300	51+00	CL	[illegible]	CH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	+[illegible]	[illegible]	[illegible]	[illegible]		
I-[illegible]	[illegible]	50'DS	50[illegible]	CH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
I-3[illegible]	[illegible]	CL	501.[illegible]	CH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	OPT	[illegible]	[illegible]	[illegible]		
I-31[illegible]	47+00	50'DS	509.7	CH	71.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
IU-320	45+00	[illegible]	[illegible]	CH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	+[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
I-32[illegible]	45+00	[illegible]'DS	508.5	CH	77.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
I-33[illegible]	[illegible]+00	CL	504.[illegible]	CL	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	+[illegible]	[illegible]	[illegible]	[illegible]		
I-335B	[illegible]	20'DS	51[illegible].1	CL	38.8	-	[illegible]	[illegible]	[illegible]	[illegible]	+[illegible]	[illegible]				
I-34[illegible]	[illegible]	50'DS	529.5	CH	7[illegible].3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	+[illegible]	[illegible]	[illegible]	[illegible]		
I-3[illegible]	5[illegible]+00	CL	[illegible].6	CH	71.6	48.0	[illegible]	[illegible]	[illegible]	[illegible]	+[illegible]	109.[illegible]				
I-3[illegible]	[illegible]+00	50'DS	529.4	CH	72.2	51.6	[illegible]	[illegible]	[illegible]	27.3	+2.1	107.9	[illegible]	[illegible]	[illegible]	27.9
I-35[illegible]	53+00	[illegible]'DS	529.3	CL	48.6	[illegible].6	100.4	20.4	100.5	23.5	-3.1	10[illegible].1				
IU-36[illegible]A	55+00	50'DS	519.8	CH	75.2	53.9	95.3	29.4	8[illegible].3	27.9	+1.5	113.0	90.8	27.9	[illegible]	[illegible]
I-36[illegible]	33+4[illegible]	2[illegible]'DS	535.0	CH	71.4	35.0	101.[illegible]	[illegible]	98.7	[illegible]	+1.[illegible]	102.7				
I-[illegible]	[illegible]	50'DS	530.[illegible]	CH	68.8	[illegible]	92.2	27.2	88.0	26.1	+1.1	110.[illegible]	[illegible]	[illegible]		
I-37[illegible]	[illegible]	CL	544.4	CH	70.9	50.7	90.[illegible]	29.9	86.7	26.7	+3.2	103.8				
IU-38[illegible]	[illegible]+00	CL	543.8	CH	74.0	53.3	96.1	28.9	84.8	27.6	+1.3	111.0	89.8	27.4	91.6	27.4
IU-3[illegible]A	[illegible]+00	CL	54[illegible]	CH	66.5	43.[illegible]	[illegible]	[illegible]	89.4	25.5	+3.1	95.3	88.2	28.0	89.0	26.3
I-[illegible]	[illegible]	CL	[illegible]	CH	73.2	52.[illegible]	[illegible]	[illegible]	85.3	27.3	+0.[illegible]	111.9	92.3	[illegible]		
I-[illegible]	[illegible]	CL	560.0	CH	72.0	51.[illegible]	93.9	[illegible]	[illegible]	27.0	+0.1	109.2				
I-[illegible]	[illegible]	CL	563.3	CH	55.4	38.3	10[illegible].1	[illegible]	94.1	22.7	OPT	109.4	[illegible]	23.7		
I-[illegible]	[illegible]	CL	[illegible]	CH	71.[illegible]	50.[illegible]	[illegible]	[illegible]	86.3	26.9	+2.1	108.3				
I-[illegible]	[illegible]+00	CL	[illegible]	CH	58.[illegible]	[illegible]	101.4	23.[illegible]	94.[illegible]	[illegible]	+0.2	107.6	[illegible]	[illegible]		
I-[illegible]A	[illegible]	CL	[illegible]	CH	45.1	-	[illegible]	[illegible]	[illegible]	19.4	+0.3	114.[illegible]				
I-[illegible]	[illegible]	CL	[illegible]	CL	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	+[illegible]	10[illegible].1	[illegible]	17.5		
I-[illegible]A	[illegible]	CL	[illegible]	CH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19.8	+[illegible]	110.0				
I-[illegible]	[illegible]	CL	[illegible]	CL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	+[illegible]	[illegible]	[illegible]	[illegible]		

NOTES ON COMPACTION CONTROL FIELD NUMBER

a. INITIAL EMBANKMENT CONTRACT

DENOTES FILL TYPE
SE SEMI-COMPACTED
R RANDOM
I IMPERVIOUS

D DENOTES THIS CONTRACT
SAMPLE NUMBER
U DENOTES RECORD SAMPLE

SEU-[illegible] A

TYPICAL FIELD NO.

RETEST DESIGNATION
A DENOTES 1ST RETEST
B DENOTES 2ND RETEST
ETC.

b. COMPLETION CONTRACT

DENOTES FILL TYPE
R RANDOM
I IMPERVIOUS

U DENOTES RECORD SAMPLE
SAMPLE NO.

RU-200 A

TYPICAL FIELD NO.

RETEST DESIGNATION
A DENOTES 1ST RETEST
B DENOTES 2ND RETEST
ETC.

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY: H. BENNETT, K. HOBBELL
DRAWN BY: [illegible]
REVISED BY: T. SCHMIDT
SUBMITTED BY: [illegible]

AQUILLA LAKE
COMPACTION CONTROL TEST DATA
FROM IMPERVIOUS FILL
COMPLETION CONTRACT

INV NO | DATED | CONTR NO | DRAWING NUMBER | SHEET NO | SEQUENCE NO

COMPACTION CONTROL TEST DATA - RANDOM FILL

TABLE 1 OF 5

SAMPLE IDENTIFICATION				CLASSIFICATION			FIELD COMPACTION CONTROL						LABORATORY COMPACTION TESTS			
				SOIL TYPE	ATTERBERG LIMITS		FIELD TESTS		LIQUID LIMIT CORRELATION		MOISTURE CONTENT AND DENSITY		GOV'T PROJECT LAB TESTS		RECORD SAMPLES SWD LAB TESTS	
FIELD NO	STATION	OFFSET	ELEV.		LL	PI	DRY DENS.	WATER CONTENT	MAX DRY DENSITY	OPT WAT CONTENT	± OF OPT	PERCENT COMPACTION	MAX DRY DENSITY	OPT WAT CONTENT	MAX DRY DENSITY	OPT WAT CONTENT
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

TABLE 2 OF 5

SAMPLE IDENTIFICATION				CLASSIFICATION			FIELD COMPACTION CONTROL						LABORATORY COMPACTION TESTS			
				SOIL TYPE	ATTERBERG LIMITS		FIELD TESTS		LIQUID LIMIT CORRELATION		MOISTURE CONTENT AND DENSITY		GOV'T PROJECT LAB TESTS		RECORD SAMPLES SWD LAB TESTS	
FIELD NO	STATION	OFFSET	ELEV.		LL	PI	DRY DENS.	WATER CONTENT	MAX DRY DENSITY	OPT WAT CONTENT	± OF OPT	PERCENT COMPACTION	MAX DRY DENSITY	OPT WAT CONTENT	MAX DRY DENSITY	OPT WAT CONTENT
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	111.3				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	96.3	23.1		
R-305	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19.5	[illegible]	104.9				
R-[illegible]A	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	111.1	[illegible]	19.0		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	108.3				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	113.5	103.6	19.9		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	103.6				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	106.8	16.2		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	106.6				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	107.0	[illegible]	16.1		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	97.5	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
RU-[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	18.0	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
RU-[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	108.3				
RU-[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	106.6	[illegible]	15.7	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	103.5				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	106.6	112.9	13.5		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	108.3				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	109.8	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
R-[illegible]A	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	102.6	112.9	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	116.8	[illegible]	[illegible]	[illegible]
R-[illegible]A	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				

TABLE 3 OF 5

SAMPLE IDENTIFICATION				CLASSIFICATION			FIELD COMPACTION CONTROL						LABORATORY COMPACTION TESTS			
				SOIL TYPE	ATTERBERG LIMITS		FIELD TESTS		LIQUID LIMIT CORRELATION		MOISTURE CONTENT AND DENSITY		GOV'T PROJECT LAB TESTS		RECORD SAMPLES SWD LAB TESTS	
FIELD NO	STATION	OFFSET	ELEV.		LL	PI	DRY DENS.	WATER CONTENT	MAX DRY DENSITY	OPT WAT CONTENT	± OF OPT	PERCENT COMPACTION	MAX DRY DENSITY	OPT WAT CONTENT	MAX DRY DENSITY	OPT WAT CONTENT
RL-[illegible]	[illegible]	[illegible]	[illegible]	CL	[illegible]	[illegible]	[illegible]	[illegible]	100.8	[illegible]	+1.1	106.6	[illegible]	[illegible]	[illegible]	[illegible]
R-[illegible]	[illegible]	[illegible]	[illegible]	CL	[illegible]	[illegible]	[illegible]	19.0	[illegible]	[illegible]	[illegible]	111.8				
R-[illegible]	[illegible]	[illegible]	[illegible]	CL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	17.9	+0.6	107.1	112.1	15.9		
R-[illegible]	[illegible]	[illegible]	[illegible]	CL	[illegible]	[illegible]	113.8	[illegible]	[illegible]	15.1	+0.6	[illegible]				
R-[illegible]	[illegible]	[illegible]	[illegible]	CL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-0.2	96.7	111.7	[illegible]		
R-[illegible]	[illegible]	[illegible]	[illegible]	CL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	17.6	-0.2	105.7				
RL-[illegible]	[illegible]	[illegible]	[illegible]	CL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	16.3	-0.8	[illegible]	111.1	15.5	113.0	15.8
R-[illegible]	[illegible]	[illegible]	[illegible]	CL	[illegible]	[illegible]	[illegible]	[illegible]	103.1	19.2	+3.3	99.9				
RL-[illegible]	[illegible]	[illegible]	[illegible]	CL	[illegible]	[illegible]	109.3	[illegible]	[illegible]	16.9	+2.2	[illegible]	108.2	16.8	[illegible]	[illegible]
R-[illegible]	[illegible]	100'DS	[illegible]	CL	[illegible]	[illegible]	[illegible]	17.5	109.4	16.3	+1.2	[illegible]				
RL-[illegible]	[illegible]	[illegible]	[illegible]	CL	[illegible]	[illegible]	[illegible]	20.6	[illegible]	[illegible]	+1.1	[illegible]	101.1	20.0	108.0	[illegible]
R-[illegible]	[illegible]	[illegible]	535.1	CH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	21.3	+3.1	100.8				
RL-[illegible]	[illegible]	[illegible]	[illegible]	CL	[illegible]	[illegible]	119.9	13.6	116.6	13.0	+0.6	102.9	[illegible]	14.5	[illegible]	[illegible]
R-[illegible]A	[illegible]	[illegible]	539.3	CL	[illegible]	[illegible]	[illegible]	[illegible]	105.8	18.0	-1.9	111.2				
R-[illegible]	[illegible]	50'DS	[illegible]	CL	[illegible]	[illegible]	[illegible]	17.9	103.8	18.9	-1.0	[illegible]	103.7	[illegible]		
R-[illegible]	[illegible]	[illegible]	[illegible]	CH	56.9	[illegible]	[illegible]	[illegible]	95.2	22.8	-0.7	109.8				
R-[illegible]	[illegible]	50'DS	539.0	CL	[illegible]	33.8	109.1	20.1	99.7	20.8	-0.7	109.6	100.5	[illegible]		
R-[illegible]	[illegible]	[illegible]	[illegible]	SC	[illegible]	[illegible]	[illegible]	15.1	107.0	17.4	-2.3	[illegible]				
R-[illegible]A	[illegible]	[illegible]	[illegible]	CL	33.3	-	[illegible]	15.8	[illegible]	16.1	-0.3	113.7	104.3	20.3		
R-[illegible]	[illegible]	[illegible]	[illegible]	CL	49.5	[illegible]	[illegible]	[illegible]	99.9	20.7	+0.8	106.6				
R-[illegible]	[illegible]	[illegible]	544.3	CL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-2.1	[illegible]	109.3	16.9		
R-[illegible]	[illegible]	[illegible]	[illegible]	CH	60.8	[illegible]	[illegible]	19.4	99.0	21.0	-1.6	114.3				
R-[illegible]	[illegible]	[illegible]	[illegible]	CL	[illegible]	[illegible]	[illegible]	18.8	[illegible]	[illegible]	+1.6	[illegible]	[illegible]	16.4		
R-[illegible]	[illegible]	[illegible]	[illegible]	CH	[illegible]	48.1	[illegible]	18.7	97.9	21.5	-0.1	114.7				
R-[illegible]	[illegible]	[illegible]	[illegible]	CL	[illegible]	[illegible]	[illegible]	18.0	[illegible]	17.8	+0.2	106.0	105.5	16.6		
R-[illegible]	[illegible]	[illegible]	[illegible]	CL	[illegible]	[illegible]	[illegible]	12.8	[illegible]	15.8	+2.0	103.5				
RL-[illegible]	[illegible]	[illegible]	547.3	CL	[illegible]	[illegible]	[illegible]	18.9	[illegible]	18.9	OPT	[illegible]	104.6	17.8	108.0	17.3
R-[illegible]	36+00	[illegible]	[illegible]	CL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	17.7	-0.2	107.5				
R-[illegible]A	[illegible]	[illegible]	[illegible]	CL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-0.9	113.8				

SAMPLE IDENTIFICATION				CLASSIFICATION		
				SOIL TYPE	ATTERBERG LIMITS	
FIELD NO	STATION	OFFSET	ELEV.		LL	PI
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

SAMPLE IDENTIFICATION				CLASSIFICATION		
				SOIL TYPE	ATTERBERG LIMITS	
FIELD NO	STATION	OFFSET	ELEV.		LL	PI
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

NOTES ON

INITIAL EMBANKMENT CONTRACT

DENOTES FILL TYPE
SE SEMI COMPACTED
R RANDOM
I IMPERVIOUS

TYPICAL FIELD NO.

SAMPLE IDENTIFICATION				CLASSIFICATION			FIELD COMPACTION CONTROL						LABORATORY COMPACTION TESTS			
				SOIL TYPE	ATTERBERG LIMITS		FIELD TESTS		LIQUID LIMIT CORRELATION		MOISTURE CONTENT AND DENSITY		GOV'T PROJECT LAB TESTS		RECORD SAMPLES SWD LAB TESTS	
FIELD NO	STATION	OFFSET	ELEV.		LL	PI	DRY DENS.	WATER CONTENT	MAX DRY DENSITY	OPT WAT CONTENT	%+ or - OF OPT	PERCENT COMPACTION	MAX DRY DENSITY	OPT WAT CONTENT	MAX DRY DENSITY	OPT WAT CONTENT
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	CH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			
[illegible]	[illegible]	[illegible]	[illegible]	CL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	CH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	CH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	CL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	CL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	CH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				

SAMPLE IDENTIFICATION				CLASSIFICATION			FIELD COMPACTION CONTROL						LABORATORY COMPACTION TESTS			
				SOIL TYPE	ATTERBERG LIMITS		FIELD TESTS		LIQUID LIMIT CORRELATION		MOISTURE CONTENT AND DENSITY		GOV'T PROJECT LAB TESTS		RECORD SAMPLES SWD LAB TESTS	
FIELD NO	STATION	OFFSET	ELEV.		LL	PI	DRY DENS.	WATER CONTENT	MAX DRY DENSITY	OPT WAT CONTENT	%+ or - OF OPT	PERCENT COMPACTION	MAX DRY DENSITY	OPT WAT CONTENT	MAX DRY DENSITY	OPT WAT CONTENT
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						

NOTES ON COMPA[illegible]

RETEST DESIGNATION
A DENOTES 1ST RETEST
B DENOTES 2ND RETEST
ETC.

R RANDOM

TYPICAL FIELD NO.

RETEST DESIGNATION

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY:
DRAWN BY:
CHECKED BY:
SUBMITTED BY:
ENGINEER
INV NO
DATED
CONTR NO
DRAWING NUMBER
SHEET NO
OF
SEQUENCE NO

RECORD SAMPLE TEST DATA: COMPLETION CONTRACT

RANDOM FILL

TABLE 1 OF 2

FIELD NUMBER	SAMPLE NUMBER	STATION	OFFSET FEET	ELEV. FEET	Gr %	Sa %	Fi %	LL	PL	W.C. %	LS	Gs	CLASS
RU-50	A-8139	86+[illegible]	50'D/S	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	14.[illegible]	[illegible]	[illegible]	CL
RU-50	A-8139-1	86+00	50'D/S	548.[illegible]	[illegible]	27	73	38	[illegible]	----	16	2.69	CL
RU-110	A-8219	73+00	50'D/S	550.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	13	[illegible]	17	2.68	CL
RU-110	A-8219-1	73+00	50'D/S	[illegible]	[illegible]	[illegible]	66	36	12	----	15	2.6[illegible]	CL
RU-90	A-8220	56+00	100'D/S	516.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	12	17.6	[illegible]	[illegible]	CL
RU-90	A-8220-1	56+00	100'D/S	516.[illegible]		26	[illegible]	36	14	----	[illegible]	2.68	CL
RU-130	A-8391	59+00	150'D/S	[illegible]	[illegible]	[illegible]	[illegible]	38	[illegible]	16.6	[illegible]	2.71	CL
RU-130	A-8391-1	58+00	150'D/S	[illegible]	[illegible]	29	71	35	[illegible]	----	[illegible]	2.70	CL
RU-140	A-8392	59+00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	13	15.8	[illegible]	2.68	CL
RU-140	A-8392-1	59+00	100'D/S	[illegible]	[illegible]	[illegible]	[illegible]	25	[illegible]	----	11	2.6[illegible]	CL
RU-150	A-8612	[illegible]	[illegible]	505.[illegible]	[illegible]	16	[illegible]	[illegible]	[illegible]	26.[illegible]	19	2.66	CH
RU-150	A-86[illegible]-1	[illegible]	[illegible]	505.[illegible]	[illegible]	18	[illegible]	51	14	----	18	2.71	CH
RU-180	A-[illegible]	63+00	50'D/S	549.0	[illegible]	24	76	33	[illegible]	16.1	13	2.69	CL
RU-180	A-8613-1	63+00	50'D/S	549.[illegible]	0	24	76	33	[illegible]	----	[illegible]	2.69	CL
RU-190	A-87[illegible]	44+00	100'D/S	515.0	1	[illegible]	59	37	13	16.9	[illegible]	2.69	CL
RU-190	A-87[illegible]-1	44+00	100'D/S	515.[illegible]	1	47	53	30	12	----	11	2.6[illegible]	CL
RU-200	A-9148	44+50	150'D/S	529.6	0	28	72	44	[illegible]	19.[illegible]	17	2.63	CL
RU-200	A-9148-1	44+50	150'D/S	524.6	[illegible]	24	71	43	13	----	13	2.61	CL
RU-210	A-9149	43+00	150'D/S	530.[illegible]	[illegible]	47	53	27	13	14.9	9	2.65	CL
RU-210	A-9149-1	43+00	150'D/S	530.[illegible]	[illegible]	54	[illegible]	26	12	----	8	2.69	SC
RU-240	A-9485	34+00	50'D/S	549.1	[illegible]	40	60	45	[illegible]	18.3	[illegible]	2.68	CL
RU-240	A-9485-1	34+00	50'D/S	549.3	[illegible]	38	62	43	[illegible]	----	[illegible]	2.74	CL
RU-360	A-10993	50+00	200'D/S	504.3	[illegible]	41	59	36	11	18.0	16	2.66	CL
RU-360	A-10993-1	50+00	200'D/S	504.3	1	37	63	33	11	----	--	2.65	CL
RU-370	A-11096	53+00	100'D/S	514.1	4	39	57	30	11	15.2	12	2.67	CL
RU-370	A-11096-1	53+00	100'D/S	514.1	0	42	58	27	13	----	--	2.68	CL
RU-390	A-12091	50+00	150'D/S	530.2	1	[illegible]	86	[illegible]	20	20.3	--	2.71	CH
RU-390	A-12091-1	50+00	150'D/S	530.2	[illegible]	[illegible]	[illegible]	37	11	----	--	2.7[illegible]	CL

FIELD NUMBER	Q-TEST W.C. %	Q-TEST γd PCF	Q-TEST c TSF	Q-TEST φ DEG	R-TEST W.C. %	R-TEST γd PCF	R-TEST c TSF	R-TEST φ DEG	DIRECT SHEAR W.C. %	DIRECT SHEAR γd PCF	DIRECT SHEAR c TSF	DIRECT SHEAR φ' DEG	CONSOLIDATION TEST e_0 %	CONSOLIDATION TEST γd PCF	CONSOLIDATION TEST C_c	COMPACTION TEST OPT W.C.	COMPACTION TEST MAX γd PCF
RU-50	20.1	[illegible]	1.0	[illegible]	20.3	[illegible]	0.2	13	18.5	[illegible]	0.19	21	[illegible]	[illegible]	[illegible]		
RU-50	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	[illegible]	[illegible]
RU-110	21.5	105	1.0	0	19.8	108	0.4	11.6	17.3	[illegible]	0.1	[illegible]	17.[illegible]	[illegible]	[illegible]		
RU-110	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	[illegible]	[illegible]
RU-90	17.9	111	.6[illegible]	1.6	17.3	114	0.5	22.[illegible]	18.4	111	[illegible]	28.[illegible]	17.[illegible]	[illegible]	[illegible]		
RU-90	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	[illegible]	[illegible]
RU-130	16.[illegible]	114	1.38	[illegible]	16.[illegible]	116	[illegible]	15.[illegible]	[illegible]	116	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
RU-130	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	[illegible]	[illegible]
RU-140	16.[illegible]	113	1.5	1.5	16.0	115	[illegible]	28	[illegible]	112	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
RU-140	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	13.4	[illegible]
RU-150	26.2	97	0.8	0	[illegible]	[illegible]	0.1	8.2	26.4	97	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
RU-150	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	[illegible]	[illegible]
RU-180	16.3	[illegible]	.6[illegible]	6.5	15.[illegible]	112	0.4	13.8	15.[illegible]	[illegible]	.23	27	16.[illegible]	[illegible]	[illegible]	--	--
RU-180	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	[illegible]	[illegible]
RU-190	[illegible]	119	[illegible]	[illegible]	17.[illegible]	111	[illegible]	[illegible]	19.6	[illegible]	.22	23.6	19.0	[illegible]	[illegible]		
RU-190	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	[illegible]	[illegible]
RU-200	17.1	[illegible]	1.1	0.8	[illegible]	99	0.1	12.9	[illegible]	96	0.3	17	25.[illegible]	[illegible]	0.21	--	
RU-200	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	[illegible]	[illegible]
RU-210	15.1	116	1.0	1.0	15.5	116	0.4	12.3	15.0	116	0.2	25.5	16.0	[illegible]	0.11		
RU-210	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	[illegible]	[illegible]
RU-240	18.5	108	.85	0	18.7	109	.12	16	19.2	108	0.1	28.1	17.[illegible]	[illegible]	[illegible]	---	----
RU-240	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	[illegible]	[illegible]
RU-360	18.1	109	[illegible]	3.0	17.7	112	.24	13.9	18.1	112	.27	[illegible]	18.5	110	[illegible]	----	
RU-360	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	[illegible]	[illegible]
RU-370	15.9	115	2.4	0	15.5	117	.41	20.5	15.1	118	.27	24.6	15.1	119	[illegible]	----	----
RU-370	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	[illegible]	[illegible]
RU-390	20.3	108	[illegible]	[illegible]	20.5	108	0.2	12.[illegible]	20.1	[illegible]	0.6	17.[illegible]	20.[illegible]	[illegible]	.19	----	----
RU-390	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	19.[illegible]	[illegible]

RANDOM FILL

TABLE 2 OF 2

FIELD NUMBER	SAMPLE NUMBER	STATION	OFFSET FEET	ELEV. FEET	Gr %	Sa %	Fi %	LL	PL	W.C. %	LS	Gs	CLASS
RU-4[illegible]0	A-12480	51+00	150'DS	529.7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	15.3		2.68	SC
RU-4[illegible]0	A-12480-1	51+00	150'DS	529.7	0	[illegible]	[illegible]	[illegible]	[illegible]			2.73	SC
RU-4[illegible]0	A-13066	47+00	50'DS	549.8	0	[illegible]	89	66	17	30.0		2.69	CH
RU-4[illegible]0	A-13066-1	47+00	50'DS	549.8	[illegible]	13	87	[illegible]	16			2.69	CH

FIELD NUMBER	Q-TEST W.C. %	Q-TEST γd PCF	Q-TEST c TSF	Q-TEST φ DEG	R-TEST W.C. %	R-TEST γd PCF	R-TEST c TSF	R-TEST φ DEG	DIRECT SHEAR W.C. %	DIRECT SHEAR γd PCF	DIRECT SHEAR c TSF	DIRECT SHEAR φ' DEG	CONSOLIDATION TEST e_0 %	CONSOLIDATION TEST γd PCF	CONSOLIDATION TEST C_c	COMPACTION TEST OPT W.C.	COMPACTION TEST MAX γd PCF
RU-4[illegible]0	16.3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	----	----
RU-4[illegible]0	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	[illegible]	[illegible]
RU-4[illegible]0	30.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	----	----
RU-4[illegible]0	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	[illegible]	[illegible]

IMPERVIOUS FILL

TABLE 1 OF

FIELD NUMBER	SAMPLE NUMBER	STATION	OFFSET FEET	ELEV. FEET	Gr %	Sa %	Fi %	LL	PL	W.C. %	LS	Gs	CLASS
IU-120A	A-8020	56+00	CL	544.1	0	20	90	56	17	25.0	19	2.66	CH
IU-120A	A-8020-1	86+00	CL	544.1	0	14	86	50	13		17	2.66	CL
IU-140A	A-8140	76+00	CL	545.1	0	[illegible]	77	49	11	22.9	19	2.66	CL
IU-140A	A-8140-1	76+00	CL	545.1	0	18	82	50	16		18	2.70	CL
IU-160B	A-8229	66+00	CL	545.0	0	11	89	68	19	28.9	21	2.71	CH
IU-160B	A-8229-1	66+00	CL	545.[illegible]	0	9	91	59	17		19	2.65	CH
IU-270	A-9250	36+00	CL	544.9	0	25	75	44	15	20.6	15	2.67	CL
IU-270	A-9250-1	36+00	CL	544.9	0	[illegible]	78	46	14		16	2.68	CL
IU-[illegible]	A-10442	49+00	CL	504.3	1	13	86	[illegible]	27	26.[illegible]	21	2.64	CH
IU-[illegible]	A-10992-1	44+00	CL	504.[illegible]	0	13	87	57	18			2.71	CH
IU-350	A-12097	46+00	50'DS	[illegible]	0	[illegible]	[illegible]	60	17	25.7	[illegible]	2.66	CH
IU-350	A-12097-1	46+00	50'DS	[illegible]	0	13	87	[illegible]	16			2.72	CH
IU-360A	A-12092	55+00	50'DS	519.8	0	[illegible]	[illegible]	72	20	28.2		2.73	CH
IU-360A	A-12092-1	55+00	50'DS	519.8	0	13	87	61	18			2.75	CH
IU-380	A-12491	46+00	CL	543.8	0	12	88	73	19	27.8		2.72	CH
IU-380	A-12491-1	46+00	CL	543.8	0	13	87	[illegible]	20			2.72	CH
IU-390A	A-13165	56+00	CL	544.2	0	11	89	57	14	29.[illegible]		2.71	CL
IU-390A	A-13165-1	56+00	CL	544.[illegible]	0	[illegible]	[illegible]	[illegible]	16			2.7[illegible]	CH

FIELD NUMBER	Q-TEST W.C. %	Q-TEST γd PCF	Q-TEST c TSF	Q-TEST φ DEG	R-TEST W.C. %	R-TEST γd PCF	R-TEST c TSF	R-TEST φ DEG	DIRECT SHEAR W.C. %	DIRECT SHEAR γd PCF	DIRECT SHEAR c TSF	DIRECT SHEAR φ' DEG	CONSOLIDATION TEST e_0 %	CONSOLIDATION TEST γd PCF	CONSOLIDATION TEST C_c	COMPACTION TEST OPT W.C.	COMPACTION TEST MAX γd PCF
IU-120A	25.3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	97	.21	20.4	----	----	----	----	----
IU-120A	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	22.[illegible]	99
IU-140A	23.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11	[illegible]	[illegible]	.19	22.5	21.6	105	[illegible]	----	----
IU-140A	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	21.[illegible]	[illegible]
IU-160B	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	15	28.[illegible]	93	[illegible]	----	----
IU-160B	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	[illegible]	[illegible]
IU-270	20.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	21.5	21.[illegible]	[illegible]	0.18	----	----
IU-270	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	19.1	[illegible]
IU-[illegible]	27.[illegible]	[illegible]	.29	[illegible]	27.[illegible]	96	.29	9.[illegible]	26.3	96	.23	15	27.8	95	0.23	----	----
IU-[illegible]	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	23.7	[illegible]
IU-350	26.[illegible]	97	[illegible]	[illegible]	[illegible]	97	[illegible]	[illegible]	26.9	97	.32	14.[illegible]	27.5	96	0.23	----	----
IU-350	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	27.9	90
IU-360A	28.9	94	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7	26.9	97	[illegible]	12.9	29.0	93	[illegible]	----	----
IU-360A	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	25.0	89
IU-380	28.[illegible]	92	.55	0	27.9	97	[illegible]	7.6	26.8	95	.45	11	29.3	90	0.33	----	----
IU-380	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	27.4	91
IU-390A	30.[illegible]	92	[illegible]	[illegible]	29.[illegible]	94	.38	8	26.3	95	0.4	13.1	29.7	89	0.27	----	----
IU-390A	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	26.3	89

NOTES ON COMPACTION CONTROL FIELD NUMBER

a. INITIAL EMBANKMENT CONTRACT

DENOTES FILL TYPE
SF SEMI-COMPACTED
R RANDOM
I IMPERVIOUS

D DENOTES THIS CONTRACT
SAMPLE NUMBER
U DENOTES RECORD SAMPLE

SFD 370 UA

TYPICAL FIELD NO.

RETEST DESIGNATION
A DENOTES 1ST RETEST
B DENOTES 2ND RETEST
ETC.

b. COMPLETION CONTRACT

DENOTES FILL TYPE
R RANDOM
I IMPERVIOUS

TYPICAL FIELD NO.

RECORD SAMPLE TEST DATA, INITIAL CONTRACT

IMPERVIOUS FILL

TABLE 1 OF 1

LOCATION					MECH. ANALYSIS	ATTERBERG LIMITS			
FIELD NUMBER	SAMPLE NUMBER	STATION	OFFSET FEET	ELEV. FEET	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

SEMI-COMPACTED FILL

TABLE 1 OF 1

LOCATION					MECH. ANALYSIS	ATTERBERG LIMITS			
FIELD NUMBER	SAMPLE NUMBER	STATION	OFFSET FEET	ELEV. FEET	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

RANDOM FILL

TABLE 1 OF 1

FIELD NUMBER	SAMPLE NUMBER	STATION	OFFSET FEET	ELEV. FEET	[illegible]
[illegible]	[illegible]	17+00	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	17+00	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	26+00	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	26+00	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	21+00	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	21+00	[illegible]	[illegible]	[illegible]

NOTES ON COMPACTION CONTROL FIELD NUMBER

DENOTES FILL TYPE

R - RANDOM

I - IMPERVIOUS

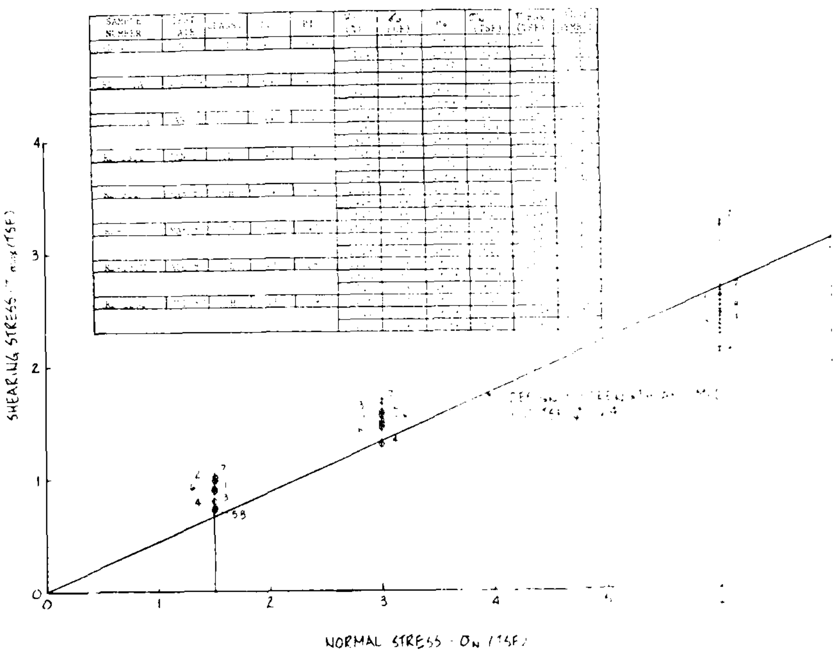
TYPICAL FIELD NO.

U.S. ARMY ENGINEER DISTRICT, FORT WORTH

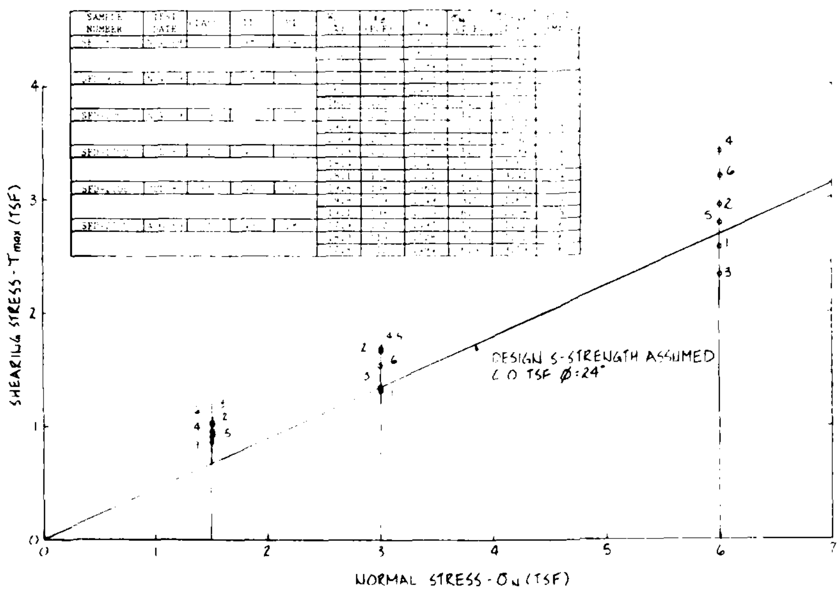
CORPS OF ENGINEERS

FORT WORTH, TEXAS

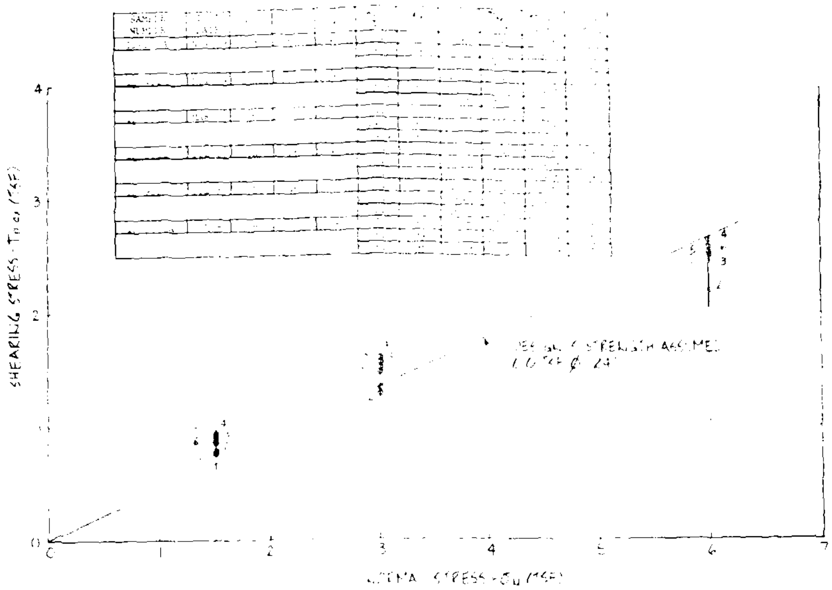
DESIGNED BY	DRAWN BY	CHECKED BY	SUBMITTED BY	INV. NO.	DATED	CONTR. NO.	DRAWING NUMBER	SHEET NO.	SEQUENCE NO.
[illegible]	[illegible]	[illegible]	[illegible]					OF	



CONSOLIDATED DRAINED (S) DIRECT SHEAR TESTS ON RAND



CONSOLIDATED-DRAINED (S) DIRECT SHEAR TESTS ON SEMI-COMPACTED FILL



CONSOLIDATED DRAINED (S) DIRECT SHEAR TESTS ON IMPERVIOUS FILL

ARMY ENGINEER DISTRICT, FORT WORTH

CORPS OF ENGINEERS

FORT WORTH, TEXAS

DE AMARE

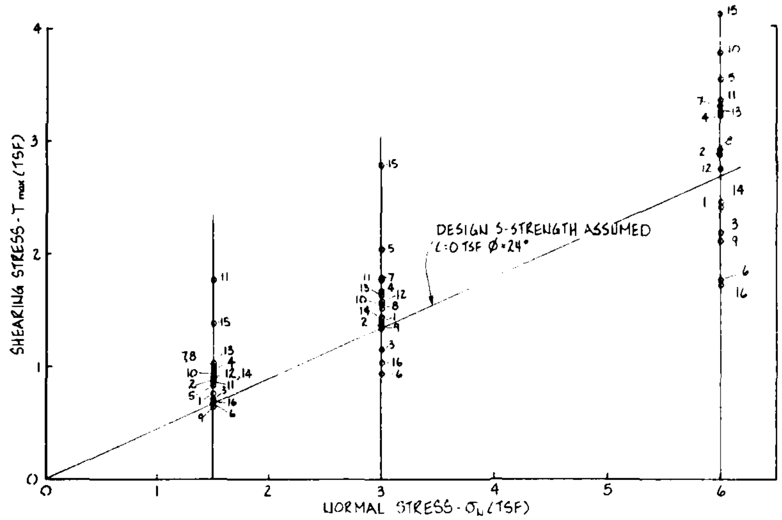
EMBANKMENT (OUTER)(1)

H. E. KARPE

SHEET NO.

SEQUENCE NO.

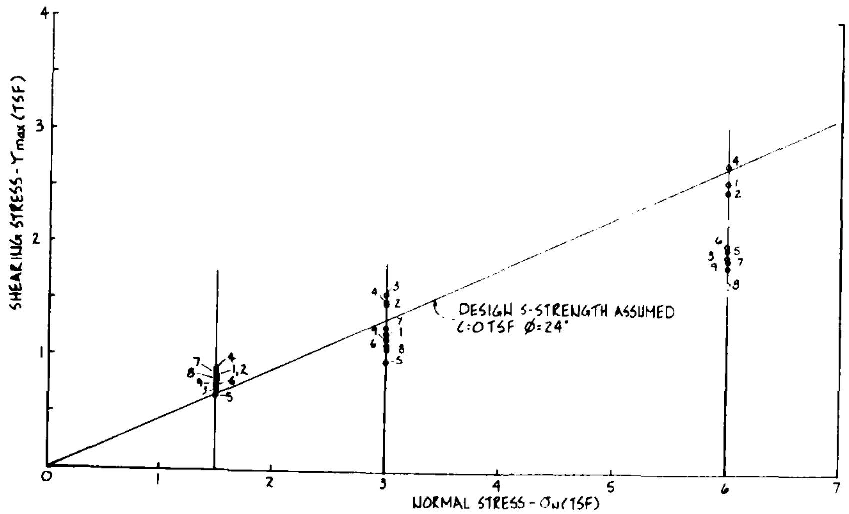
PLATE 22



CONSOLIDATED - DRAINED (S) DIRECT SHEAR TESTS ON RANDOM FILL

Consolidated-Drained (S) Direct Shear Tests [illegible]

SAMPLE NUMBER	TEST DATE	CLASS.	LL	PI	W_c (%)	γ_d (PCF)
RC-50	DEC 81	CL	[illegible]	[illegible]	[illegible]	[illegible]
RC-110	JAN 82	CL	[illegible]	[illegible]	[illegible]	[illegible]
RC-90	JAN 82	CL	[illegible]	[illegible]	[illegible]	[illegible]
RC-130	MAR 82	CL	[illegible]	[illegible]	[illegible]	[illegible]
RC-140	MAR 82	CL	[illegible]	[illegible]	[illegible]	[illegible]
RC-150	MAY 82	CH	[illegible]	[illegible]	[illegible]	[illegible]
RC-180	MAY 82	CL	[illegible]	[illegible]	[illegible]	[illegible]
RC-190	MAY 82	CL	37	[illegible]	[illegible]	[illegible]
RC-200	JUN 83	CL	[illegible]	[illegible]	[illegible]	[illegible]
RC-210	JUN 83	CL	[illegible]	[illegible]	[illegible]	[illegible]
RC-280	MAY 83	CL	[illegible]	[illegible]	[illegible]	[illegible]
RC-360	MAY 83	CL	[illegible]	[illegible]	[illegible]	[illegible]
RC-370	MAY 83	CL	[illegible]	[illegible]	[illegible]	[illegible]
RC-390	APR 83	CH	[illegible]	[illegible]	[illegible]	[illegible]
RC-430	APR 83	SC	[illegible]	[illegible]	[illegible]	[illegible]
RC-470	APR 83	CH	[illegible]	[illegible]	[illegible]	[illegible]



CONSOLIDATED - DRAINED (S) DIRECT SHEAR TESTS ON IMPERVIOUS FILL

Consolidated-Drained (S) Direct Shear Test [illegible]

SAMPLE NUMBER	TEST DATE	CLASS.	LL	PI	W_c (%)	[illegible]
IC-120A	DEC 81	CH	[illegible]	[illegible]	[illegible]	[illegible]
IC-140A	DEC 81	CL	[illegible]	[illegible]	[illegible]	[illegible]
IC-160B	JAN 82	CH	[illegible]	[illegible]	[illegible]	[illegible]
IC-270	MAY 83	CL	[illegible]	[illegible]	[illegible]	[illegible]
IC-320	MAY 83	CH	[illegible]	[illegible]	[illegible]	[illegible]
IC-350	MAY 83	CH	[illegible]	[illegible]	[illegible]	[illegible]
IC-360A	APR 83	CH	[illegible]	[illegible]	[illegible]	[illegible]
IC-38[illegible]	APR 83	CH	[illegible]	[illegible]	[illegible]	[illegible]
IC-390A	APR 83	CL	[illegible]	[illegible]	[illegible]	[illegible]

Consolidated-Drained (S) Direct Shear Tests on Random Fill (Completion Contract)

SAMPLE NUMBER	TEST DATE	CLASS.	LL	PI	W_c (%)	γ_d (PCF)	e_o	σ_n (TSF)	τ_{max} (TSF)	PLOT SYMBOL
RC-[illegible]	DEC 81	CL	[illegible]	[illegible]	18.8	109	.515	1.5	0.75	1
					18.5	109	.507	3.0	1.39	1
					18.2	110	.499	6.0	2.40	1
RC-[illegible]	JAN 82	CL	43	30	16.5	114	.455	1.5	0.83	2
					17.8	113	.478	3.0	1.35	2
					17.5	114	.459	6.0	2.86	2
RC-90	JAN 82	CL	40	28	18.0	111	.515	1.5	0.70	3
					18.3	111	.509	3.0	1.15	3
					18.8	110	.528	6.0	2.16	3
RC-130	MAR 82	CL	38	26	17.8	115	.463	1.5	0.97	4
					15.9	118	.428	3.0	1.66	4
					17.2	116	.450	6.0	3.21	4
RC-140	MAR 82	CL	29	18	14.8	118	.413	1.5	0.84	5
					14.7	119	.398	3.0	2.02	5
					14.4	119	.403	6.0	3.53	5
RC-150	MAY 82	CH	56	41	26.3	97	.695	1.5	0.66	6
					27.5	96	.728	3.0	0.93	6
					26.9	97	.701	6.0	1.77	6
RC-160	MAY 82	CL	33	21	14.7	120	.393	1.5	0.98	7
					15.5	119	.406	3.0	1.78	7
					15.5	120	.398	6.0	3.28	7
RC-190	MAY 82	CL	37	24	19.0	110	.516	1.5	0.98	8
					18.0	110	.522	3.0	1.51	8
					18.7	110	.522	6.0	2.90	8
RC-200	JUN 83	CL	44	30	26.2	95	.711	1.5	0.65	9
					26.3	98	.666	3.0	1.34	9
					26.2	96	.705	6.0	2.09	9
RC-210	JUN 83	CL	27	14	14.8	117	.402	1.5	0.92	10
					15.2	115	.436	3.0	1.53	10
					15.0	117	.410	6.0	3.75	10
RC-280	MAY 83	CL	35	22	18.7	108	.540	1.5	0.91	11
					19.3	109	.526	3.0	1.76	11
					19.5	108	.547	6.0	3.33	11
RC-360	MAY 83	CL	36	25	18.0	112	.475	1.5	0.89	12
					18.3	111	.487	3.0	1.55	12
					17.9	112	.475	6.0	2.73	12
RC-370	MAY 83	CL	30	19	15.7	117	.416	1.5	0.99	13
					14.9	118	.412	3.0	1.63	13
					14.8	118	.408	6.0	3.24	13
RC-390	APR 83	CH	77	57	20.2	110.7	.530	1.5	0.89	14
					20.0	111.6	.510	3.0	1.43	14
					20.0	108.2	.560	6.0	2.41	14
RC-430	APR 83	SC	26	12	12.3	122.1	.370	1.5	1.37	15
					11.8	123.2	.360	3.0	2.77	15
					13.7	117.5	.420	6.0	4.10	15
RC-470	APR 83	CH	66	49	29.9	92.4	.820	1.5	0.69	16
					28.4	94.0	.790	3.0	1.03	16
					28.0	93.4	.800	6.0	1.71	16

LEGEND

CLASS	SAMPLE CLASSIFICATION ACCORDING TO UNIFIED SOIL CLASSIFICATION SYSTEM
LL	LIQUID LIMIT
PI	PLASTICITY INDEX
W_c	MOISTURE CONTENT
γ_d	DRY DENSITY
e_o	INITIAL VOID RATIO
σ_n	NORMAL STRESS
τ_{max}	SHEAR STRESS AT FAILURE

Consolidated-Drained (S) Direct Shear Tests on Impervious Fill (Completion Contract)

SAMPLE NUMBER	TEST DATE	CLASS.	LL	PI	W_c (%)	γ_d (PCF)	e_o	σ_n (TSF)	τ_{max} (TSF)	PLOT SYMBOL
IC-120A	DEC 81	CH	56	39	25.6	97	.689	1.5	0.82	1
					25.0	98	.666	3.0	1.21	1
					25.2	97	.688	6.0	2.57	1
IC-140A	DEC 81	CL	49	36	23.2	102	.618	1.5	0.82	2
					24.6	99	.665	3.0	1.48	2
					23.4	101	.633	6.0	2.49	2
IC-[illegible]	JAN 82	CH	68	49	27.4	94	.799	1.5	0.70	3
					28.7	94	.781	3.0	1.06	3
					28.4	93	.805	6.0	1.91	3
IC-[illegible]	MAY 83	CL	[illegible]	[illegible]	21.0	106	.559	1.5	0.89	4
					21.2	106	.563	3.0	1.49	4
					20.2	108	.540	6.0	2.72	4
IC-[illegible]	MAY 83	CH	62	45	26.9	96	.708	1.5	0.66	5
					26.1	95	.731	3.0	0.97	5
					25.9	98	.680	6.0	1.97	5
IC-[illegible]	MAY 83	CH	60	43	25.4	98	.685	1.5	0.74	6
					26.4	96	.713	3.0	1.11	6
					25.5	98	.679	6.0	2.09	6
IC-360A	APR 83	CH	72	52	26.7	98.2	.730	1.5	0.84	7
					26.4	98.0	.740	3.0	1.29	7
					27.5	95.1	.790	6.0	1.99	7
IC-[illegible]	APR 83	CH	73	54	25.2	96.2	.760	1.5	0.81	8
					28.0	91.2	.840	3.0	1.09	8
					27.2	96.0	.740	6.0	1.68	8
IC-390A	APR 83	CL	47	33	27.9	94.9	.780	1.5	0.75	9
					28.4	95.0	.780	3.0	1.17	9
					28.6	[illegible]	.790	6.0	1.82	9

NOTE:
NO RECORD SAMPLE TESTS PREFORMED ON SEMI-COMPACTED FILL PLACED DURING COMPLETION CONTRACT

SYMBOL NO.	ACTION	DATE	DESCRIPTION OF REVISION

U S ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

AQUILLA LAKE
EMBANKMENT RECORD SAMPLE TESTS
CONSOLIDATED-DRAINED (S) DIRECT SHEAR TESTS ON RANDOM & IMPERVIOUS FILL
(COMPLETION CONTRACT)

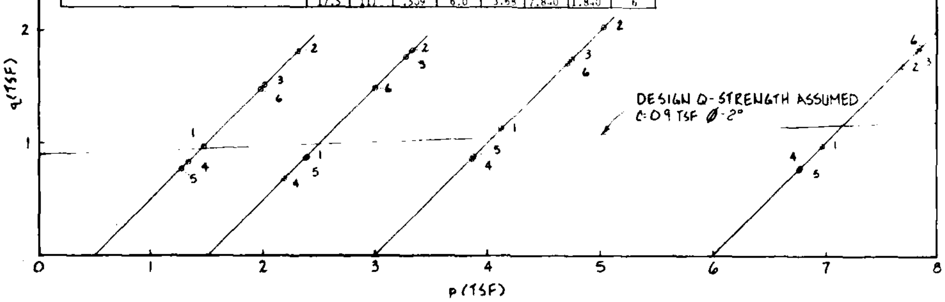
DESIGNED BY: N BENNETT, R HOWELL
DRAWN BY: L DELAMARE
REVIEWED BY: T SCHMIDT
SUBMITTED BY: H.E. KARBS
ENGINEER

INV NO | DATED
CONTR NO
DRAWING NUMBER | SHEET NO OF | SEQUENCE NO

PLATE 23

Unconsolidated-Undrained (Q) Tests on Semi-Compacted Fill (Initial Embankment Contract)

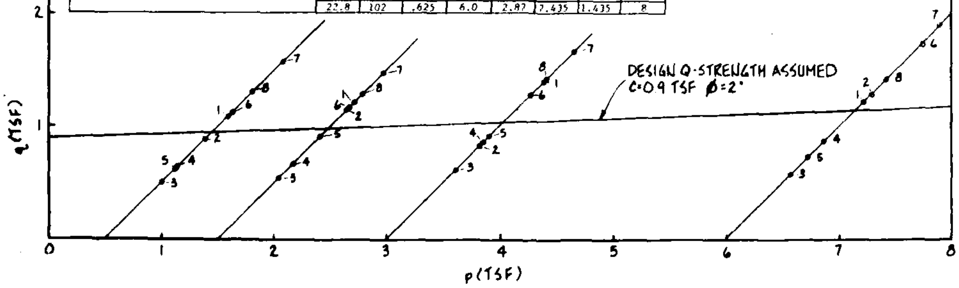
SAMPLE NUMBER	TEST DATE	CLASS.	LL	PI	W_c (%)	γ_d (PCF)	e_o	σ_3 (TSF)	$(\sigma_1-\sigma_3)_m$ (TSF)	p (TSF)	q (TSF)	PLOT SYMBOL
SFD-80U	NOV 79	CL	48	34	24.0	98	.699	0.5	1.93	1.465	0.965	1
					24.7	97	.717	1.5	1.78	2.390	0.890	1
					25.9	95	.753	3.0	2.24	4.120	1.120	1
					23.6	99	.691	6.0	1.92	6.960	0.960	1
SFD-90U	NOV 79	CL	39	27	15.1	117	.436	0.5	3.62	2.310	1.810	2
					15.8	116	.451	1.5	3.66	3.330	1.830	2
					15.5	116	.452	3.0	4.05	5.025	2.025	2
					15.3	117	.437	6.0	3.37	7.685	1.685	2
SFD-100U	NOV 79	CH	51	37	20.3	106	.576	0.5	3.01	2.005	1.505	3
					18.9	107	.551	1.5	3.53	3.265	1.765	3
					19.2	108	.535	3.0	3.49	4.745	1.745	3
					19.1	107	.552	6.0	3.62	7.810	1.810	3
SFD-170U	JUL 80	CL	40	27	22.6	102	.663	0.5	1.67	1.335	0.835	4
					24.1	99	.705	1.5	1.37	2.185	0.685	4
					19.1	107	.589	3.0	1.70	3.850	0.850	4
					21.8	103	.652	6.0	1.57	6.785	0.785	4
SFD-210U	JUL 80	CL	45	32	18.6	110	.536	0.5	1.54	1.270	0.770	5
					19.5	108	.558	1.5	1.75	2.375	0.875	5
					19.7	107	.580	3.0	1.73	3.865	0.865	5
					18.8	110	.531	6.0	1.53	6.765	0.765	5
SFD-270U	AUG 80	CL	40	28	17.1	111	.506	0.5	2.95	1.975	1.475	6
					17.9	111	.518	1.5	2.98	2.990	1.490	6
					19.2	106	.576	3.0	3.40	4.700	1.700	6
					17.5	111	.509	6.0	3.68	7.840	1.840	6



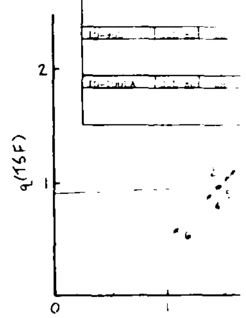
UNCONSOLIDATED-UNDRAINED (Q) TESTS ON SEMI-COMPACTED FILL

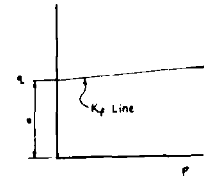
Unconsolidated-Undrained (Q) Triaxial Shear Tests on Random Fill (Initial Embankment Contract)

SAMPLE NUMBER	TEST DATE	CLASS.	LL	PI	W_c (%)	γ_d (PCF)	e_o	σ_3 (TSF)	$(\sigma_1-\sigma_3)_m$ (TSF)	p (TSF)	q (TSF)	PLOT SYMBOL
RD-40U	JUN 79	CL	47	34	20.3	106	.561	0.5	2.18	1.590	1.090	1
					19.7	107	.544	1.5	2.44	2.720	1.220	1
					19.2	109	.525	3.0	2.80	4.400	1.400	1
					19.2	109	.524	6.0	2.43	7.215	1.215	1
RD-30UA	NOV 79	CL	41	27	19.5	109	.528	0.5	1.78	1.390	0.890	2
					19.2	109	.534	1.5	2.30	2.650	1.150	2
					20.1	107	.561	3.0	1.65	3.825	0.825	2
					19.1	109	.523	6.0	2.58	7.290	1.290	2
RD-120UA	JAN 80	CL	44	31	26.0	96	.739	0.5	1.01	1.005	0.505	3
					25.9	97	.712	1.5	1.09	2.045	0.545	3
					25.9	97	.714	3.0	1.23	3.615	0.615	3
					25.5	98	.697	6.0	1.15	6.575	0.575	3
RD-130U	JAN 80	CL	47	34	23.4	100	.662	0.5	1.29	1.145	0.645	4
					23.0	101	.652	1.5	1.35	2.175	0.675	4
					21.7	103	.617	3.0	1.71	3.855	0.855	4
					22.0	103	.620	6.0	1.74	6.870	0.870	4
RD-90U	FEB 80	CH	54	38	27.8	94	.753	0.5	1.24	1.120	0.620	5
					27.2	95	.740	1.5	1.83	2.415	0.915	5
					26.5	96	.717	3.0	1.81	3.905	0.905	5
					27.6	96	.726	6.0	1.47	6.735	0.735	5
RD-110U	FEB 80	CH	60	42	26.4	96	.674	0.5	2.26	1.630	1.130	6
					25.7	97	.663	1.5	2.31	2.655	1.155	6
					26.1	96	.679	3.0	2.56	4.280	1.280	6
					24.5	99	.633	6.0	3.48	7.740	1.740	6
RD-180U	AUG 80	CL	43	28	20.7	101	.649	0.5	3.17	2.085	1.585	7
					24.7	96	.725	1.5	2.96	2.980	1.480	7
					23.4	99	.669	3.0	3.33	4.665	1.665	7
					20.3	104	.591	6.0	3.80	7.900	1.900	7
RD-220U	JUL 80	CH	53	39	23.2	101	.630	0.5	2.60	1.800	1.300	8
					23.1	101	.628	1.5	2.59	2.795	1.295	8
					22.0	103	.605	3.0	2.84	4.420	1.420	8
					22.8	102	.625	6.0	2.87	7.435	1.435	8



UNCONSOLIDATED-UNDRAINED (Q) TRIAXIAL SHEAR TESTS ON RANDOM FILL (INITIAL EMBANKMENT CONTRACT)

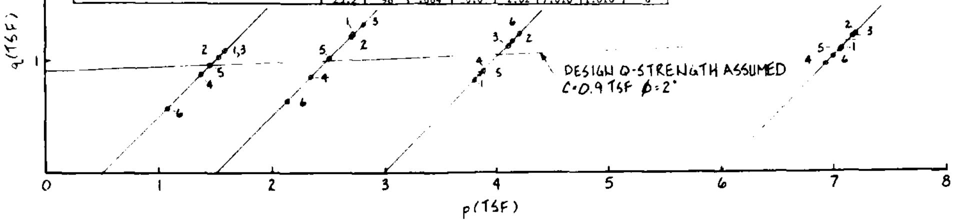




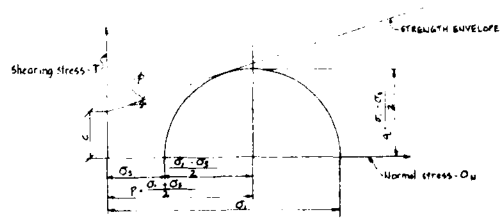
Relationship of 'c' and 'φ' t...
line on p-q diagram

Unconsolidated-Undrained (Q) Triaxial Shear Tests on Impervious Fill (Initial Embankment Contract)

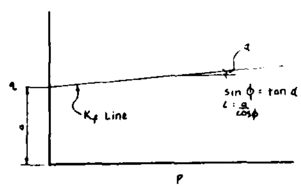
SAMPLE NUMBER	TEST DATE	CLASS.	LL	PI	W_c (%)	γ_d (PCF)	e_o	σ_3 (TSF)	$(\sigma_1-\sigma_3)_m$ (TSF)	p (TSF)	q (TSF)	PLOT SYMBOL
1D-20UA	NOV 79	CH	62	43	27.1	95	.746	[illegible]	[illegible]	[illegible]	[illegible]	1
					25.3	97	.703	1.5	2.45	2.725	1.225	1
					27.7	92	.792	3.0	1.61	3.805	0.805	1
					25.6	95	.741	6.0	[illegible]	7.070	1.070	1
1D-40B	NOV 79	CH	52	36	24.0	100	.668	0.5	2.06	1.530	1.030	2
					23.1	101	.645	1.5	2.41	2.705	1.205	2
					22.8	102	.629	3.0	2.31	4.155	1.155	2
					22.2	103	.617	6.0	2.42	7.210	1.210	2
1D-100G	FEB 80	CH	53	37	22.9	99	.665	0.5	2.17	1.585	1.085	3
					22.7	99	.661	1.5	2.62	2.810	1.310	3
					23.1	99	.671	3.0	2.24	4.120	1.120	3
					23.9	99	.676	6.0	2.38	7.190	1.190	3
1D-80UC	JUL 80	CH	56	40	26.4	96	.713	0.5	1.75	1.375	0.875	4
					27.6	95	.741	1.5	1.69	2.345	0.845	4
					27.2	95	.731	3.0	1.77	3.885	0.885	4
					26.5	96	.713	6.0	1.90	6.950	0.950	4
1D-20C	JUL 80	CL	46	33	23.3	101	.648	0.5	1.92	1.460	0.960	5
					23.5	100	.662	1.5	2.02	2.510	1.010	5
					24.7	99	.685	3.0	1.72	3.860	0.860	5
					22.8	101	.643	6.0	2.16	7.080	1.080	5
1D-100UA	JUL 80	CH	53	38	26.4	96	.719	0.5	1.14	1.070	0.570	6
					25.2	97	.691	1.5	1.27	2.135	0.635	6
					23.9	100	.652	3.0	2.43	4.215	1.215	6
					25.2	98	.684	6.0	2.02	7.010	1.010	6



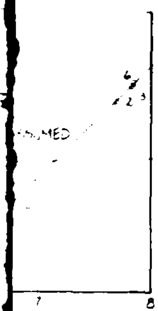
UNCONSOLIDATED-UNDRAINED (Q) TRIAXIAL SHEAR TESTS ON IMPERVIOUS FILL

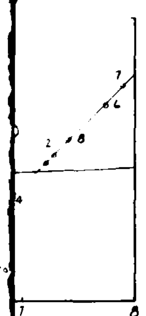


DETERMINATION OF "p" AND "q" FROM
TRIAXIAL TEST USING MOHR'S DIAGRAM



Relationship of "c" and "ϕ" to K_f line on p-q diagram

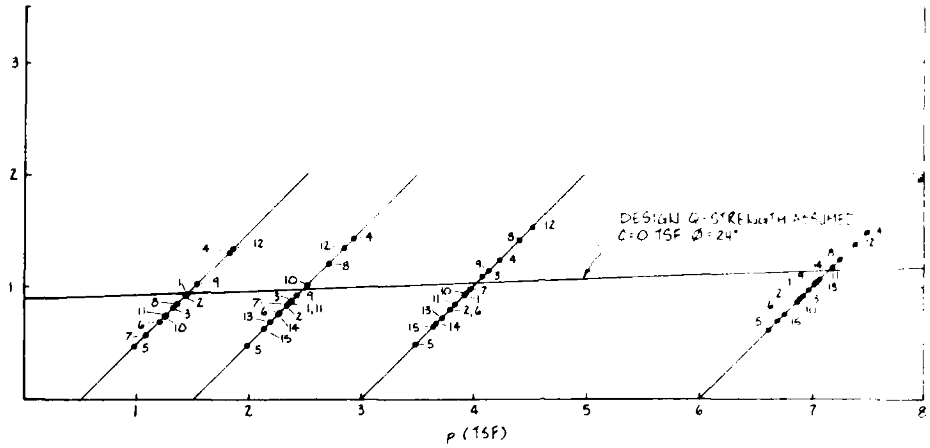




MENT CONTRACT)

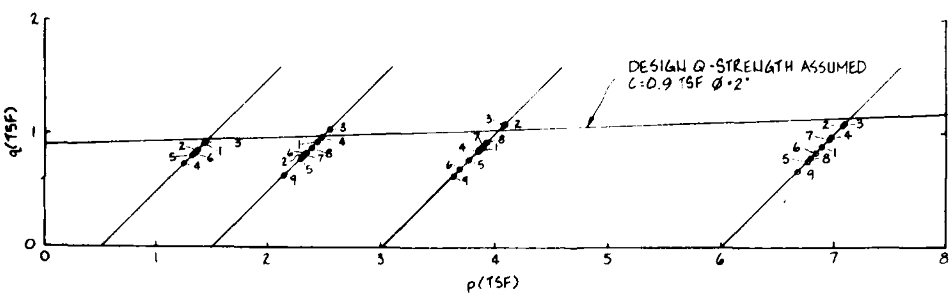
	U.S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS
DESIGNED BY: L. PEIRCE, R. HOWELL DRAWN BY: L. DE LA MARE REVIEWED BY: T. SCHMIDT	AQUILLA LAKE EMBANKMENT RECORD SAMPLE TESTS UNCONSOLIDATED-UNDRAINED (Q) TESTS ON RANDOM, IMPERVIOUS, & SEMI-COMPACTED FILL (INITIAL EMBANKMENT CONTRACT)
SUBMITTED BY: H.E. KARBS, ENGINEER	INV NO / DATED / CONTR NO / DRAWING NUMBER / SHEET NO

PLATE 24



UNCONSOLIDATED-UNDRAINED (Q) TRIAXIAL SHEAR TESTS ON RANDOM FILL

RL-3[illegible]	MAY 83	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RL-390	APR 83	CH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RL-430	APR 83	SC	26	[illegible]	[illegible]	[illegible]	[illegible]
RL-470	APR 83	CH	66	[illegible]	[illegible]	[illegible]	[illegible]



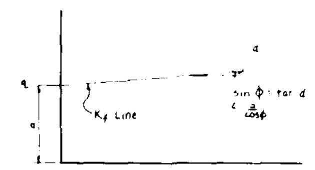
UNCONSOLIDATED-UNDRAINED (Q) TRIAXIAL SHEAR TESTS ON IMPERVIOUS FILL

Unconsolidated-Undrained (Q) Triaxial Shear Tests on [illegible]

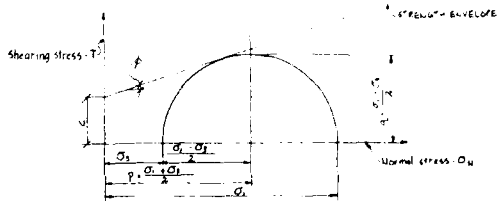
SAMPLE NUMBER	TEST DATE	CLASS.	LL	PI	W_c (%)	γ_d (PCF)	[illegible]
IU-120A	DEC 81	CH	56	39	24.9	[illegible]	[illegible]
					25.0	98	[illegible]
					26.1	97	[illegible]
					25.1	98	[illegible]
IU-140A	DEC 81	CL	49	36	23.4	100	[illegible]
					[illegible]	[illegible]	[illegible]
					[illegible]	102	[illegible]
					23.2	[illegible]	[illegible]
IU-160B	JAN 82	CH	68	44	29.2	[illegible]	[illegible]
					29.5	91	[illegible]
					29.5	92	[illegible]
					29.6	92	[illegible]
IU-270	MAY 83	CL	44	29	21.4	[illegible]	[illegible]
					[illegible]	[illegible]	[illegible]
					21.4	[illegible]	[illegible]
					20.5	106	[illegible]
IU-320	MAY 83	CH	62	45	26.6	96	[illegible]
					27.3	96	[illegible]
					27.5	95	[illegible]
					27.0	96	[illegible]
IU-350	MAY 83	CH	60	43	26.0	97	[illegible]
					26.2	96	[illegible]
					26.8	94	[illegible]
					25.7	97	[illegible]
IU-360A	APR 83	CH	72	52	29.1	94	.82
					28.9	94.6	.8
					28.8	94.4	[illegible]
IU-380	APR 83	CH	73	54	28.3	95.6	[illegible]
					28.5	95.0	[illegible]
					28.6	94.8	.81
IU-390A	APR 83	CL	47	33	29.9	92.4	[illegible]
Note: Second test gave LL-54, PI-36					30.4	91.6	[illegible]
					[illegible]	92.1	[illegible]

[illegible] Triaxial Shear Tests on Random Fill (Completion Contract)

SAMPLE NUMBER	TEST DATE	CLASS.	LL	PI	W_c (%)	γd (PCF)	e_o	σ_3 (TSF)	$(\sigma_1-\sigma_3)_m$ (TSF)	p (TSF)	q (TSF)	PLOT SYMBOL
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.537	[illegible]	1.69	1.445	[illegible]	[illegible]
					[illegible]	106	[illegible]	1.5	[illegible]	2.355	[illegible]	[illegible]
					[illegible]	106	.552	3.0	1.82	3.920	0.920	[illegible]
					[illegible]	102	.544	6.0	1.93	6.965	0.965	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	105	.589	0.5	1.88	1.440	0.940	[illegible]
					[illegible]	105	.590	1.5	1.66	2.330	0.830	[illegible]
					[illegible]	104	.604	3.0	1.59	3.795	0.795	[illegible]
					[illegible]	106	.569	6.0	1.79	6.895	0.895	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	112	.496	0.5	1.63	[illegible]	0.815	[illegible]
					[illegible]	111	.507	1.5	1.75	2.375	0.875	[illegible]
					[illegible]	111	.534	3.0	2.18	4.090	1.090	[illegible]
					[illegible]	111	.515	6.0	1.82	6.910	0.91	[illegible]
[illegible]	MAR [illegible]	[illegible]	35	[illegible]	16.9	113	[illegible]	0.5	2.62	1.810	[illegible]	[illegible]
					16.9	114	.483	1.5	2.83	2.915	[illegible]	[illegible]
					[illegible]	114	.475	3.0	2.45	4.225	1.225	[illegible]
					15.8	115	.462	6.0	2.95	7.475	1.475	[illegible]
[illegible]	MAR [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	112	.483	0.5	0.93	0.965	0.465	[illegible]
					16.7	113	.476	1.5	0.96	1.980	[illegible]	[illegible]
					16.7	113	.472	3.0	0.96	3.480	0.480	[illegible]
					15.7	114	.461	6.0	1.23	6.615	0.615	[illegible]
[illegible]	MAY [illegible]	CH	56	[illegible]	26.4	96	.715	0.5	1.39	1.195	0.695	6
					26.4	97	.708	1.5	1.56	2.280	0.780	6
					26.6	97	.711	3.0	1.59	3.795	0.795	6
					25.9	98	.693	6.0	1.51	6.755	0.755	6
[illegible]	MAY [illegible]	CL	33	21	17.1	112	.489	0.5	1.13	1.065	0.565	7
					17.1	113	.481	1.5	1.69	2.345	0.845	7
					16.8	114	.460	3.0	1.94	3.970	0.970	7
					15.0	116	.442	6.0	3.92	7.960	1.960	7
[illegible]	[illegible] 83	CL	44	30	18.6	110	.479	0.5	1.70	1.350	0.850	[illegible]
					16.5	113	.447	1.5	2.40	2.700	1.200	[illegible]
					[illegible]	113	.440	3.0	2.80	[illegible]	[illegible]	[illegible]
					16.7	113	.443	6.0	2.49	7.245	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	116	.415	0.5	2.06	1.530	1.030	[illegible]
					[illegible]	117	.413	1.5	1.85	2.425	0.925	[illegible]
					[illegible]	116	.419	3.0	2.28	4.140	[illegible]	[illegible]
					[illegible]	[illegible]	.425	6.0	2.08	7.040	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	107	.552	0.5	[illegible]	[illegible]	[illegible]	[illegible]
					[illegible]	107	.551	1.5	[illegible]	2.525	[illegible]	[illegible]
					[illegible]	[illegible]	[illegible]	3.0	[illegible]	[illegible]	[illegible]	[illegible]
					18.7	108	.548	6.0	1.72	6.860	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	36	[illegible]	[illegible]	[illegible]	.524	0.5	1.49	[illegible]	[illegible]	[illegible]
					17.8	109	.515	1.5	1.71	2.355	[illegible]	[illegible]
					18.0	109	.518	3.0	1.68	3.840	[illegible]	[illegible]
					18.2	109	.510	6.0	2.11	7.055	1.055	[illegible]
[illegible]	MAR 83	[illegible]	[illegible]	[illegible]	15.9	115	[illegible]	0.5	2.69	1.845	[illegible]	[illegible]
					17.0	114	.455	1.5	2.68	2.840	[illegible]	[illegible]
					[illegible]	116	.433	3.0	3.04	4.520	1.520	[illegible]
					15.5	116	[illegible]	6.0	2.76	7.380	1.380	[illegible]
[illegible]	APR [illegible]	[illegible]	[illegible]	37	20.7	107.3	.57	1.5	1.38	2.190	0.690	[illegible]
					20.7	107.4	.58	3.0	1.45	3.725	0.725	[illegible]
					19.6	109.8	.54	6.0	2.06	7.030	1.030	[illegible]
[illegible]	APR 83	[illegible]	[illegible]	[illegible]	16.7	[illegible]	.48	1.5	1.54	2.270	0.770	[illegible]
					17.0	[illegible]	.49	3.0	1.32	3.660	0.660	[illegible]
					[illegible]	114.5	.46	6.0	2.35	7.175	1.175	[illegible]
[illegible]	APR 83	CH	66	[illegible]	30.5	92	.83	1.5	1.26	2.130	[illegible]	[illegible]
					30.2	91.9	.83	3.0	1.29	3.645	0.645	[illegible]
					30.7	91.3	.84	6.0	1.39	6.695	0.695	[illegible]



Relationship of c and ϕ to K_f line on p-q diagram



DETERMINATION OF p AND q FROM TRIAXIAL TEST USING MOHR'S DIAGRAM

[illegible] Unconsolidated-Undrained (Q) Triaxial Shear Tests on Impervious Fill (Completion Contract)

SAMPLE NUMBER	TEST DATE	CLASS.	LL	PI	W_c (%)	γd (PCF)	e_o	σ_3 (TSF)	$(\sigma_1-\sigma_3)_m$ (TSF)	p (TSF)	q (TSF)	PLOT SYMBOL
[illegible]A	DEC 81	CH	56	39	24.9	98	.664	0.5	1.84	1.420	0.920	1
					25.0	98	.670	1.5	1.85	2.425	0.925	1
					26.1	97	.689	3.0	1.72	3.860	0.860	1
					25.1	98	.667	6.0	1.78	6.890	0.890	1
[illegible]A	DEC 81	CL	49	36	23.4	100	.650	0.5	1.70	1.350	0.850	2
					25.2	98	.692	1.5	1.60	2.300	0.800	2
					22.1	102	.617	3.0	2.17	4.085	1.085	2
					23.2	101	.634	6.0	2.13	7.065	1.065	2
[illegible]B	JAN 82	CH	68	49	29.2	90	.859	0.5	1.87	1.435	0.935	3
					29.5	91	.858	1.5	2.09	2.545	1.045	3
					29.5	91	.854	3.0	2.16	4.080	1.080	3
					29.6	91	.848	6.0	2.17	7.085	1.085	3
[illegible]	MAY 83	CL	44	29	21.4	105	.579	0.5	1.45	1.225	0.725	4
					20.0	107	.551	1.5	1.96	2.480	0.980	4
					21.4	104	.593	3.0	1.70	3.850	0.850	4
					20.5	106	.564	6.0	1.94	6.970	0.970	4
[illegible]	MAY 83	CH	62	45	26.8	96	.707	0.5	1.62	1.310	0.810	5
					27.3	96	.716	1.5	1.57	2.285	0.785	5
					27.5	95	.718	3.0	1.52	3.760	0.760	5
					27.0	96	.706	6.0	1.52	6.760	0.760	5
[illegible]	MAY 83	CH	60	43	26.0	97	.704	0.5	1.65	1.325	0.825	6
					26.2	96	.712	1.5	1.65	2.325	0.825	6
					26.8	96	.723	3.0	1.39	3.695	0.695	6
					25.7	97	.697	6.0	1.68	6.840	0.840	6
IU-360A	APR 83	CH	72	52	29.1	94	.81	1.5	1.63	2.315	0.815	7
					28.9	94.6	.8	3.0	1.78	3.890	0.890	7
					28.8	94.4	.8	6.0	1.90	6.950	0.950	7
IU-380	APR 83	CH	73	54	28.3	95.6	.8	1.5	1.74	2.370	0.870	8
					28.5	95.0	.81	3.0	1.82	3.910	0.910	8
					28.6	94.8	.81	6.0	1.56	6.780	0.780	8
IU-390A	APR 83	CL	47	33	29.9	92.4	.83	1.5	1.28	2.140	0.640	9
Note: Second test gave LL-54, PI-36					30.4	91.6	.85	3.0	1.27	3.635	0.635	9
					30.2	92.1	.84	6.0	1.32	6.660	0.660	9

NOTE:
NO RECORD SAMPLE TESTS PREFORMED ON SEMI-COMPACTED FILL PLACED DURING COMPLETION CONTRACT.

SYMBOL NO.	ACTION	DATE	DESCRIPTION OF REVISION

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

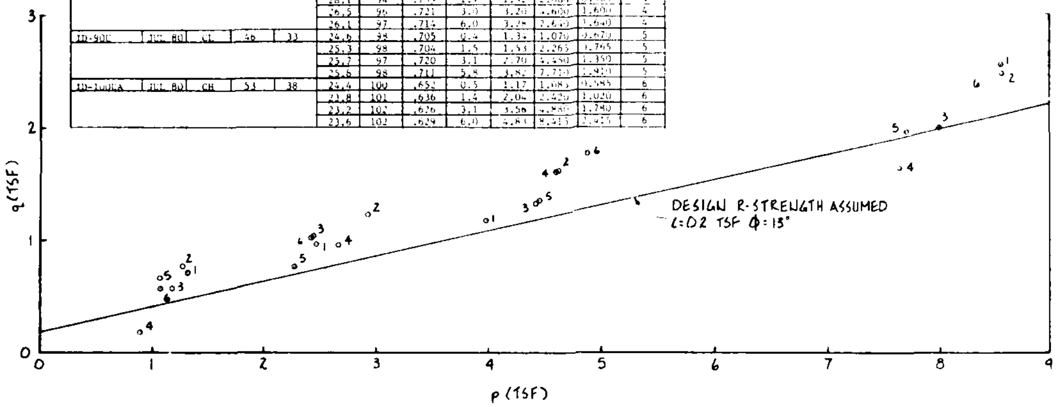
DESIGNED BY: N. PELLUETT, R. HOLWELL
DRAWN BY: L. DELANARE
REVIEWED BY: C. SCHMIDT
SUBMITTED BY: H.E. KARBS, ENGINEER

AQUILLA LAKE
EMBANKMENT RECORD SAMPLE TESTS
UNCONSOLIDATED-UNDRAINED (Q) TESTS
ON RANDOM & IMPERVIOUS FILL
(COMPLETION CONTRACT)

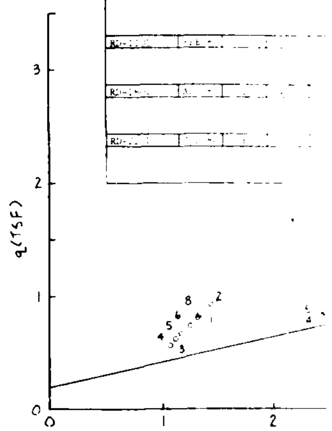
INV NO | DATED
CONTR NO
DRAWING NUMBER | SHEET NO OF

Consolidated-Undrained (R) Triaxial Shear Tests on Impervious Fill (Initial Embankment Contract)

SAMPLE NUMBER	TEST DATE	CLASS.	LL	PI	W_c (%)	γ_d (PCF)	e_o	σ_3 (TSF)	$(\sigma_1-\sigma_3)_m$ (TSF)	p (TSF)	q (TSF)	PLOT SYMBOL
ID-20UA	NOV 79	CH	[illegible]	[illegible]	25.1	93	.783	0.6	1.43	1.33	0.715	1
					27.6	95	.759	1.5	1.94	[illegible]	0.970	1
					[illegible]	[illegible]	.754	2.8	2.30	3.980	1.150	1
					[illegible]	98	.702	6.0	5.13	8.565	2.565	1
ID-40U	NOV 79	CH	52	36	23.2	113	.631	0.5	1.56	1.280	0.780	2
					23.2	[illegible]	.617	1.7	2.45	2.925	1.225	2
					[illegible]	[illegible]	.600	3.0	3.24	4.620	1.620	2
					23.2	112	.642	6.1	4.98	8.590	2.490	2
ID-30UU	FEB 80	CH	55	37	[illegible]	99	.674	0.6	1.17	1.185	0.585	3
					23.5	100	.663	1.4	2.09	2.445	1.045	3
					23.1	97	.705	3.1	2.64	4.420	1.320	3
					23.9	99	.681	6.0	4.00	8.000	2.000	3
ID-80UC	JUL 80	CH	58	40	27.3	95	.758	0.6	0.39	0.795	0.195	4
					28.1	94	.759	1.7	1.92	2.660	0.960	4
					26.5	96	.721	3.0	3.20	4.600	1.600	4
					26.1	97	.714	6.0	3.28	7.640	1.640	4
ID-90U	JUL 80	CL	46	33	24.6	98	.705	0.4	1.34	1.070	0.670	5
					25.3	98	.704	1.5	1.53	2.265	0.765	5
					25.7	97	.720	3.1	2.70	4.450	1.350	5
					25.6	98	.711	5.8	3.82	7.710	1.910	5
ID-100UA	JUL 80	CH	53	38	24.4	100	.652	0.5	1.17	1.085	0.585	6
					21.8	101	.636	1.4	2.04	2.420	1.020	6
					23.2	102	.626	3.1	3.56	4.880	1.780	6
					23.6	102	.629	6.0	4.83	8.415	2.415	6



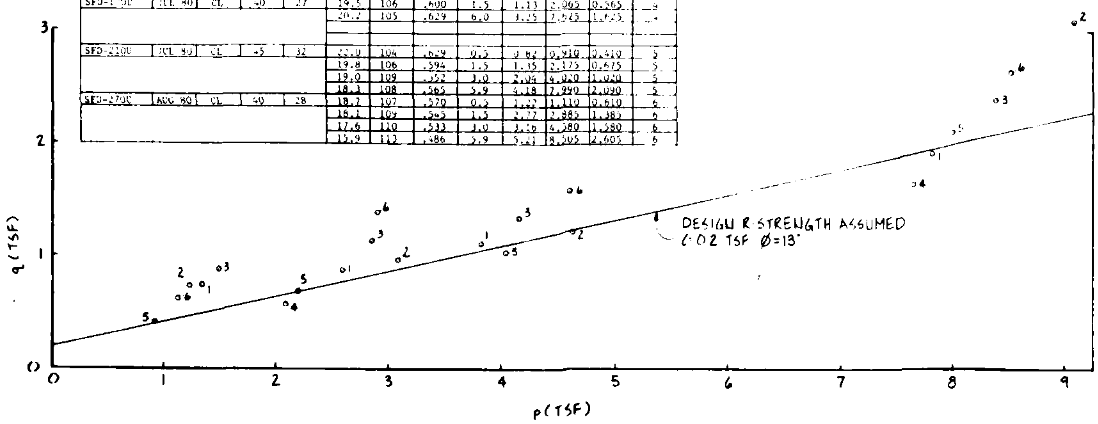
CONSOLIDATED-UNDRAINED (R) TRIAXIAL SHEAR TESTS ON IMPERVIOUS FILL



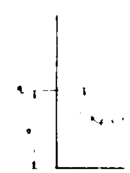
CONSOLIDATED-UNDRA

Consolidated-Undrained (R) Triaxial Shear Tests on Semi-Compacted Fill (Initial Embankment Contract)

SAMPLE NUMBER	TEST DATE	CLASS.	LL	PI	W_c (%)	γ_d (PCF)	e_o	σ_3 (TSF)	$(\sigma_1-\sigma_3)_m$ (TSF)	p (TSF)	q (TSF)	PLOT SYMBOL
SFD-80U	NOV 79	CL	48	34	19.5	107	.570	0.6	1.47	1.335	0.735	1
					21.7	103	.637	1.7	1.74	2.570	0.870	1
					20.9	105	.598	2.7	2.20	3.800	1.100	1
					18.4	109	.537	5.9	3.80	7.800	1.900	1
SFD-90U	NOV 79	CL	39	27	16.2	114	.479	0.6	1.44	1.320	0.720	2
					16.1	115	.469	1.6	2.91	3.055	1.455	2
					15.2	114	.488	2.9	3.41	4.605	1.705	2
					15.2	118	.433	6.0	6.16	9.080	3.080	2
SFD-100U	NOV 79	CL	51	37	18.6	110	.526	0.6	1.75	1.475	0.875	3
					19.1	107	.568	1.7	2.26	2.830	1.130	3
					18.2	107	.565	2.8	2.67	4.135	1.335	3
					18.7	110	.526	6.0	4.77	8.385	2.385	3
SFD-170U	JUL 80	CL	40	27	19.5	106	.600	1.5	1.13	2.065	0.565	4
					20.2	105	.629	6.0	3.25	7.625	1.625	4
SFD-220U	JUL 80	CL	45	32	22.0	104	.629	0.5	0.82	0.910	0.410	5
					19.8	106	.594	1.5	1.35	2.175	0.675	5
					19.0	109	.552	3.0	2.04	4.020	1.020	5
					18.3	108	.565	5.9	4.18	7.990	2.090	5
SFD-270U	AUG 80	CL	40	28	18.7	107	.570	0.5	1.22	1.110	0.610	6
					16.1	109	.545	1.5	2.77	2.885	1.385	6
					17.6	110	.533	3.0	3.16	4.580	1.580	6
					15.9	113	.486	5.9	5.21	8.505	2.605	6



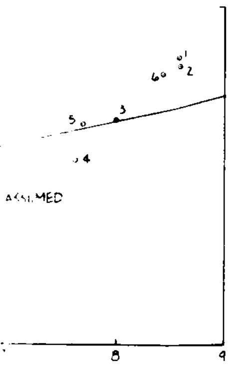
CONSOLIDATED-UNDRAINED (R) TRIAXIAL SHEAR TESTS ON SEMI-COMPACTED FILL

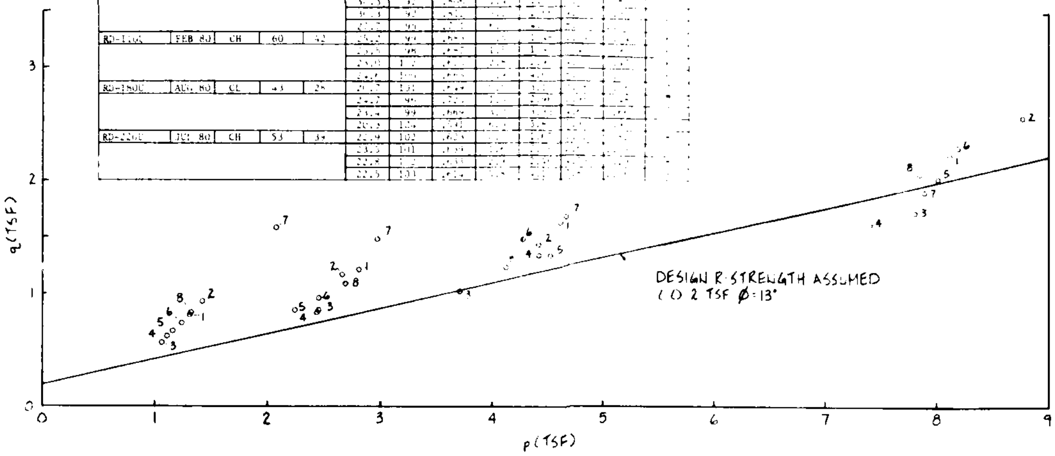


5 6 7 8 9

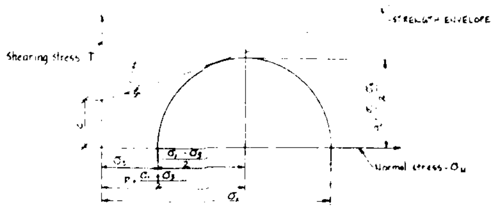
Consolidated-Undrained (R) Triaxial Shear Tests [illegible]

SAMPLE NUMBER	TEST DATE	CLASS.	LL	PI	w (%)	γ_d (PCF)	e_o	σ_3 (TSF)	$(\sigma_1-\sigma_3)_f$ (TSF)	p	q	[illegible]
[illegible]	JUN 79	CL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					14.8	110	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RD-[illegible]A	[illegible] 79	CL	41	27	19.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					[illegible]	107	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					19.2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RD-[illegible]A	JAN 80	CL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RD-[illegible]	JAN 80	CL	47	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RD-90U	FEB 80	CH	[illegible]	38	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					[illegible]	92	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					[illegible]	92	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					[illegible]	90	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RD-110U	FEB 80	CH	60	42	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					[illegible]	98	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RD-150U	AUG 80	CL	43	26	20.7	101	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					24.7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					23.4	99	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					20.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RD-220U	JUL 80	CH	53	[illegible]	22.9	102	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					23.3	101	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					22.8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					22.5	101	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

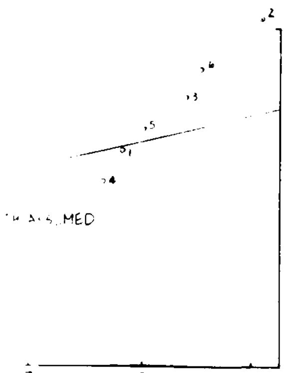


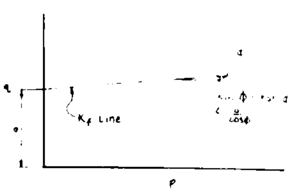


CONSOLIDATED-UNDRAINED (R) TRIAXIAL SHEAR TESTS ON RANDOM FILL



DETERMINATION OF p AND q FROM TRIAXIAL TEST USING MOHRS DIAGRAM





Relationship of c and ϕ to K_f line on p-q diagram

SYMBOL NO.	ACTION	DATE	DESCRIPTION OF REVISION

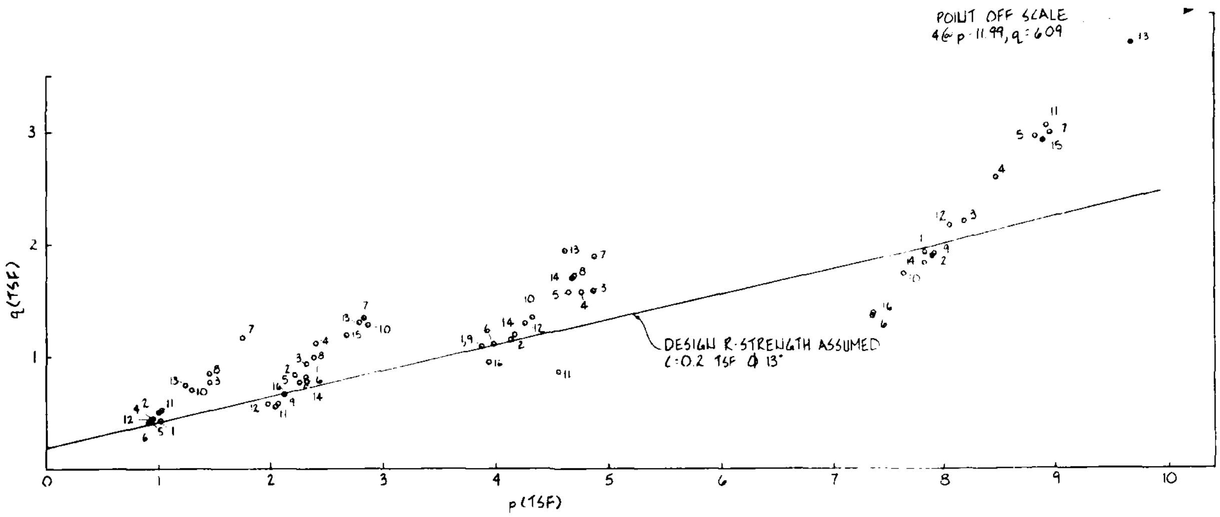
U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

AGUILLA [illegible]

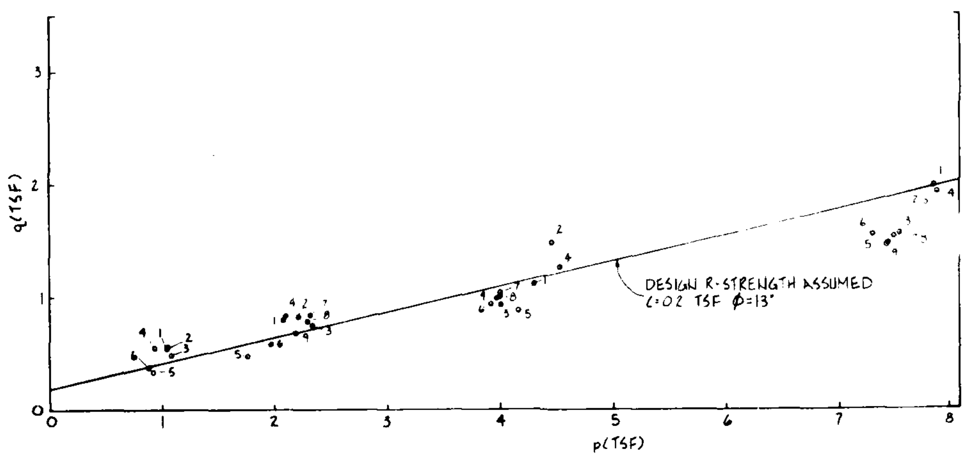
EMBANKMENT RECORD SAMPLE TESTS
CONSOLIDATED-UNDRAINED (R) TESTS ON
RANDOM, IMPERVIOUS, & SEMI-COMPACTED FILL
(INITIAL EMBANKMENT CONTRACT)

DESIGNED BY: [illegible]
DRAWN BY: [illegible]
CHECKED BY: [illegible]
SUBMITTED BY: H.F. KARBS, ENGINEER
INV. N: DATED
CONTR. NO.
DRAWING NUMBER
SHEET NO. OF
SEQUENCE NO.

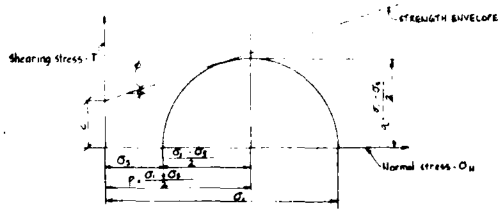
5 6 7 8



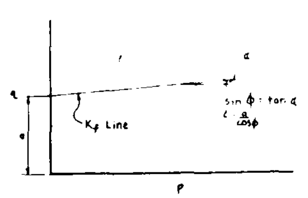
CONSOLIDATED-UNDRAINED (R) TRIAXIAL SHEAR TESTS ON RANDOM FILL



CONSOLIDATED-UNDRAINED (R) TRIAXIAL SHEAR TESTS ON IMPERVIOUS FILL



DETERMINATION OF p AND q FROM TRIAXIAL TEST USING MOHR'S DIAGRAM



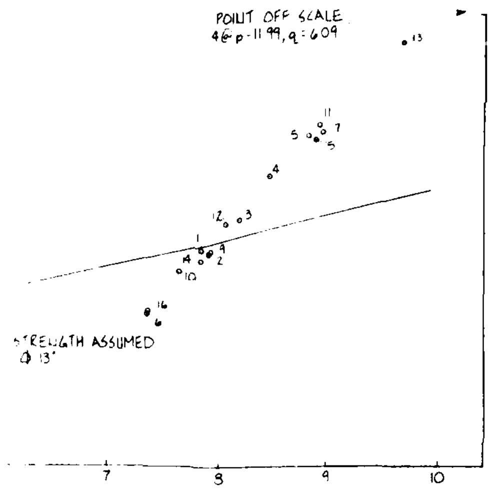
Relationship of 'c' and 'Φ' to Kf line on p-q diagram

LEGEND:

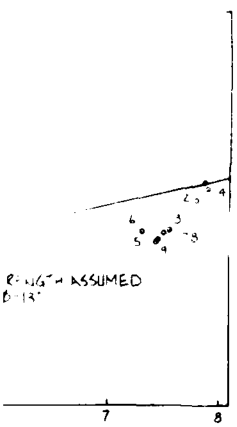
CLASS	SAMPLE CLASSIFICATION ACCORDING TO UNIFIED SOIL CLASSIFICATION SYSTEM
LL	LIQUID LIMIT
PI	PLASTICITY INDEX
W_c	WATER CONTENT
γd	DRY DENSITY
e_o	INITIAL VOID RATIO
σ_1	MAJOR PRINCIPAL STRESS
σ_3	MINOR PRINCIPAL STRESS
$(\sigma_1 - \sigma_3)m$	DEVIATOR STRESS AT FAILURE
p	$\frac{\sigma_1 + \sigma_3}{2}$
q	$\frac{\sigma_1 - \sigma_3}{2}$

Consolidated-Undrained (R) Triaxial Shear Tests on Impervious

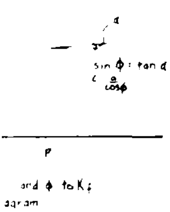
SAMPLE NUMBER	TEST DATE	CLASS.	LL	PI	W_c (%)	γd (PCF)	e_o
IU-120A	DEC 81	CH	56	39	25.9	97	.705
					26.5	96	[illegible]
					26.6	97	.70[illegible]
					24.9	99	.666
IU-140A	DEC 81	CL	49	36	23.6	10[illegible]	.637
					23.1	102	.626
					23.0	102	.62[illegible]
					22.7	103	.615
IU-160B	JAN 82	CH	68	49	29.3	93	.82[illegible]
					30.5	92	[illegible]
					28.9	93	[illegible]
					28.4	95	[illegible]
IU-270	MAY 83	CL	44	29	23.6	101	[illegible]
					21.2	105	[illegible]
					20.7	106	[illegible]
					[illegible]	[illegible]	[illegible]
IU-320	MAY 83	CH	62	45	27.3	95	[illegible]
					28.0	95	[illegible]
					26.9	96	[illegible]
					26.9	96	[illegible]
IU-350	MAY 83	CH	60	43	26.1	99	.65[illegible]
					24.3	101	[illegible]
					26.6	98	.70[illegible]
					25.8	99	.65[illegible]
IU-360A	APR 83	CH	72	52	28.5	95.1	.79[illegible]
					29.2	93.9	[illegible]
					28.2	95.6	.78
IU-380	APR 83	CH	73	54	27.0	97.4	.76[illegible]
					27.6	96.5	.780
					28.2	95.9	.79[illegible]
IU-390A	APR 83	CL	47	33	29.9	93.0	.82[illegible]
					29.1	94.0	.80[illegible]
					29.2	[illegible]	[illegible]



... ON RANDOM FILL



... FILL



LEGEND

CLASS	SAMPLE CLASSIFICATION ACCORDING TO UNIFIED SOIL CLASSIFICATION SYSTEM
LL	LIQUID LIMIT
PI	PLASTICITY INDEX
W_c	WATER CONTENT
γ_d	DRY DENSITY
e_o	INITIAL VOID RATIO
σ_1	MAJOR PRINCIPAL STRESS
σ_3	MINOR PRINCIPAL STRESS
$(\sigma_1 - \sigma_3)_m$	DEVIATOR STRESS AT FAILURE
p	$\frac{\sigma_1 + \sigma_3}{2}$
q	$\frac{\sigma_1 - \sigma_3}{2}$

Consolidated-Undrained (R) Triaxial Shear Tests on Random Fill (Completion Contract)

SAMPLE NUMBER	TEST DATE	CLASS.	LL	PI	W_c (%)	γ_d (PCF)	e_o	σ_3 (TSF)	$(\sigma_1-\sigma_3)_m$ (TSF)	p (TSF)	q (TSF)	PLOT SYMBOL
RU-[illegible]	DEC [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RU-[illegible]	JAN [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RU-[illegible]	JAN [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RU-[illegible]	MAY [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RU-240	MAY [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RU-250	MAY [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	98	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					[illegible]	[illegible]	.662	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					[illegible]	110	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RU-260	MAY [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	119	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					[illegible]	117	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					[illegible]	116	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					[illegible]	117	.435	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RU-[illegible]	MAY [illegible]	CL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.6	[illegible]	[illegible]	[illegible]	[illegible]
					[illegible]	109	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					18.2	110	.526	3.0	[illegible]	[illegible]	[illegible]	[illegible]
					[illegible]	117	.439	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RU-[illegible]	JAN [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	96	.714	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					[illegible]	98	.672	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RU-[illegible]	JAN [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.429	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					15.6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RU-[illegible]	MAY [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					16.7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RU-[illegible]	MAY [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	12
					[illegible]	[illegible]	.509	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					17.6	[illegible]	.482	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					16.9	[illegible]	.462	[illegible]	[illegible]	[illegible]	2.255	[illegible]
RU-370	MAY [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	116	.441	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					15.8	116	.432	[illegible]	[illegible]	[illegible]	1.295	[illegible]
					14.9	118	.412	[illegible]	3.85	[illegible]	[illegible]	[illegible]
					[illegible]	118	.412	[illegible]	[illegible]	[illegible]	3.755	13
RU-320	APR 83	CH	[illegible]	[illegible]	[illegible]	107.8	.570	1.6	[illegible]	[illegible]	[illegible]	[illegible]
					[illegible]	108.2	.560	3.0	2.35	[illegible]	[illegible]	[illegible]
					[illegible]	108.2	.560	6.0	[illegible]	7.815	1.815	[illegible]
RU-430	APR 83	SC	26	[illegible]	[illegible]	[illegible]	.470	[illegible]	[illegible]	2.680	1.180	15
					15.9	114.5	.460	3.0	3.38	4.690	1.690	15
					[illegible]	115.2	.450	6.0	5.80	8.900	2.900	15
RU-470	APR 83	CH	[illegible]	49	31.6	90.4	.860	1.5	[illegible]	2.105	[illegible]	16
					30.1	92.4	.820	3.0	1.88	3.940	[illegible]	16
					31.4	90.7	.850	6.0	2.71	7.355	1.355	16

Consolidated-Undrained (R) Triaxial Shear Tests on Impervious Fill (Completion Contract)

SAMPLE NUMBER	TEST DATE	CLASS.	LL	PI	W_c (%)	γ_d (PCF)	e_o	σ_3 (TSF)	$(\sigma_1-\sigma_3)_m$ (TSF)	p (TSF)	q (TSF)	PLOT SYMBOL
IL-[illegible]A	DEC 81	CH	56	39	25.9	97	.705	0.5	1.09	1.045	0.545	1
					26.5	96	.710	1.3	1.57	2.085	0.785	1
					26.6	97	.704	3.2	2.22	4.310	1.110	1
					24.9	99	.666	5.9	3.91	7.855	1.955	1
IL-[illegible]A	DEC 81	CL	49	36	23.6	101	.637	0.5	1.10	1.050	0.550	2
					23.1	102	.626	1.4	1.63	2.215	0.815	2
					23.0	102	.621	3.0	2.95	4.475	1.475	2
					22.7	103	.615	6.0	3.63	7.815	1.815	2
IL-[illegible]B	JAN 82	CH	68	49	29.3	93	.827	0.6	0.96	1.080	0.480	3
					30.5	92	.843	1.6	1.48	2.340	0.740	3
					28.9	93	.813	3.1	1.84	4.020	0.920	3
					28.4	95	.789	6.0	3.10	7.550	1.550	3
IL-[illegible]	MAY 83	CL	44	29	23.8	101	.647	0.4	1.08	0.940	0.540	4
					21.2	105	.581	1.3	1.60	2.100	0.800	4
					20.7	106	.567	3.3	2.51	4.555	1.255	4
					20.2	107	.552	6.0	3.83	7.915	1.915	4
IL-[illegible]	MAY 83	CH	62	45	27.3	96	.711	0.6	0.65	0.925	0.325	5
					28.0	95	.738	1.3	0.92	1.760	0.460	5
					26.9	96	.710	3.3	1.74	4.170	0.870	5
					26.9	96	.714	6.0	2.92	7.460	1.460	5
IL-[illegible]	MAY 83	CH	60	43	26.1	99	.682	0.5	0.76	0.880	0.380	6
					24.3	101	.640	1.4	1.15	1.975	0.575	6
					26.6	98	.702	3.0	1.86	3.930	0.930	6
					25.8	99	.681	5.8	3.03	7.315	1.515	6
IL-360A	APR 83	CH	72	52	28.5	95.1	.790	1.5	1.63	2.315	0.815	7
					29.2	93.9	.820	3.0	2.02	4.010	..010	7
					28.2	95.6	.780	6.0	3.03	7.515	1.515	7
IL-380	APR 83	CH	73	54	27.0	97.4	.760	1.5	1.55	2.275	0.775	8
					27.6	96.5	.780	3.0	2.01	4.005	1.005	8
					28.2	95.9	.790	6.0	3.03	7.515	1.515	8
IL-390A	APR 83	CL	47	33	29.9	93.0	.820	1.5	1.37	2.185	0.685	9
					29.1	94.0	.800	3.0	1.96	3.980	0.980	9
					29.2	94.2	.800	6.0	2.91	7.455	1.455	9

NOTE:
NO RECORD SAMPLE TESTS PREFORMED ON SEMI-COMPACTED FILL PLACED DURING COMPLETION CONTRACT.

SYMBOL	DESCRIPTION	DATE	APPROVAL

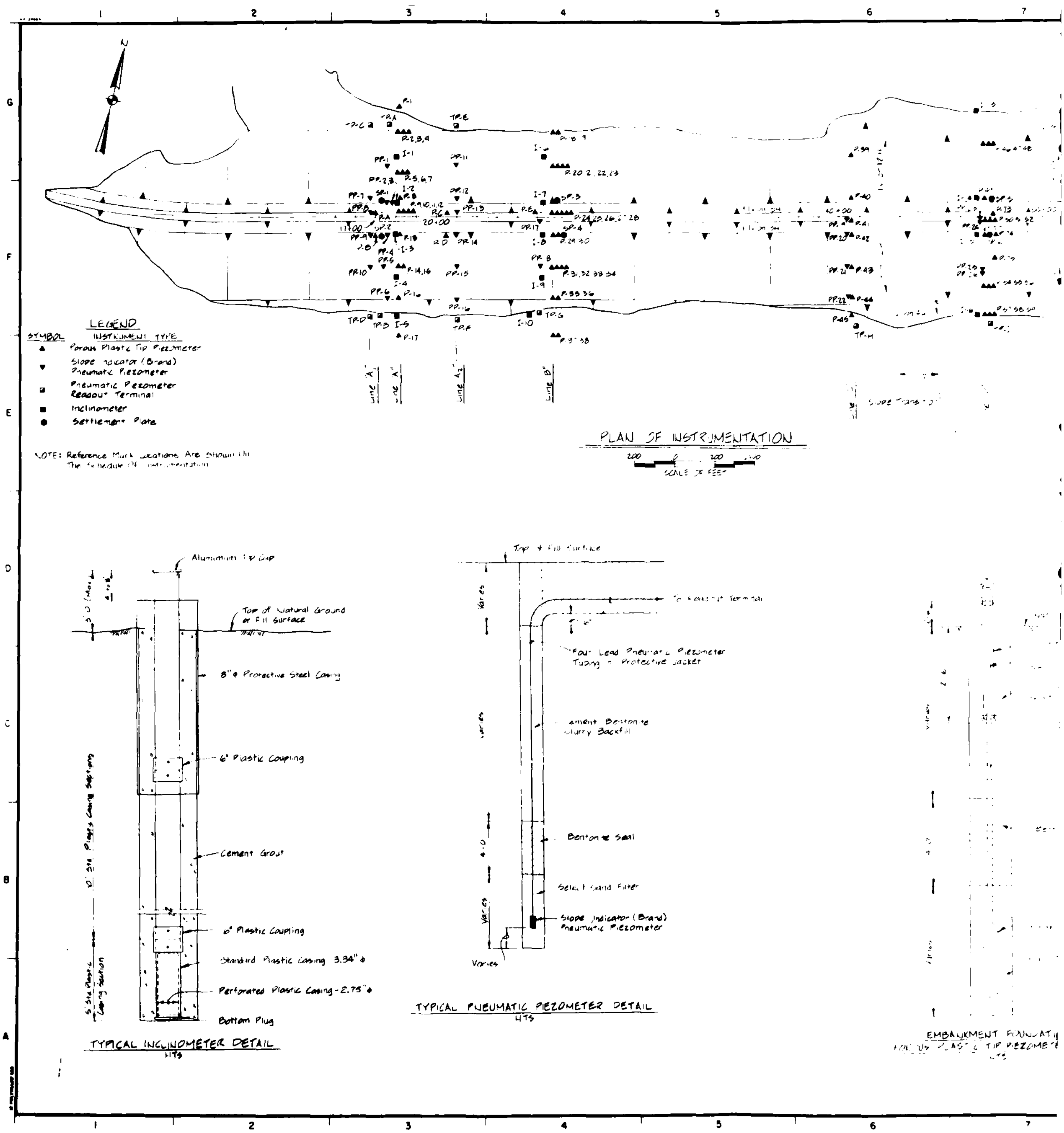
U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY: D. BENNETT
E. HOWELL
DRAWN BY: L. DELAMARE
REVIEWED BY: T. SCHMIDT

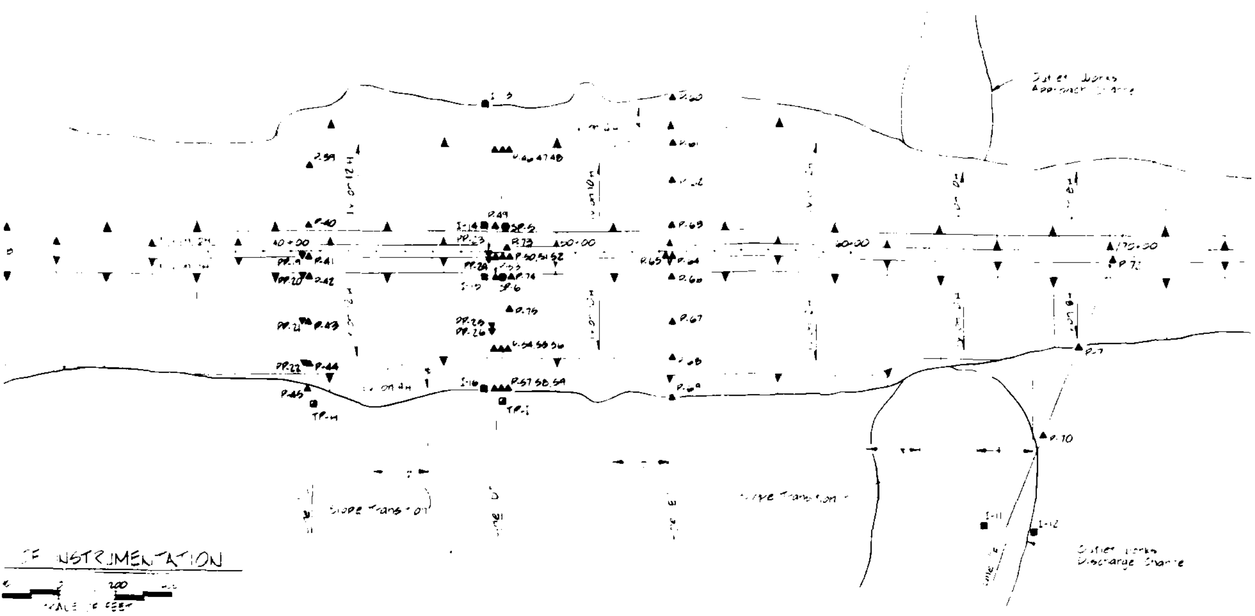
AQUILLA LAKE
EMBANKMENT RECORD SAMPLE TESTS
CONSOLIDATED-UNDRAINED (R) TRIAXIAL SHEAR TESTS ON RANDOM & IMPERVIOUS FILL
(COMPLETION CONTRACT)

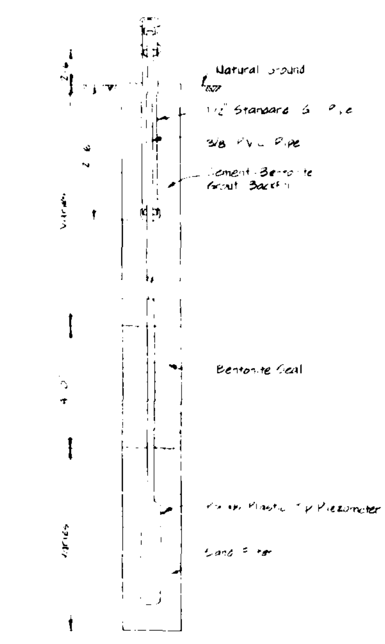
SUBMITTED BY: H.E. KARBS
ENGINEER
INV NO | DATED
CONTR NO
DRAWING NUMBER | SHEET NO

PLATE 27

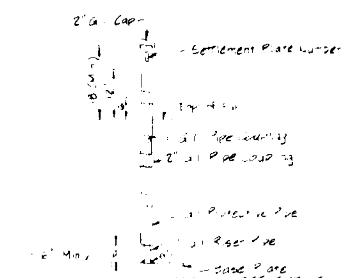


LEGEND
SYMBOL
INSTRUMENT TYPE
Porous Plastic Tip Piezometer
Slope Indicator (Brand) Pneumatic Piezometer
Pneumatic Piezometer Readout Terminal
Inclinometer
Settlement Plate
NOTE: Reference Mark Locations Are Shown On The Schedule Of Instrumentation
PLAN OF INSTRUMENTATION
SCALE OF FEET
Aluminum Top Cap
Top of Natural Ground or Fill Surface
8" Protective Steel Casing
6" Plastic Coupling
Cement Grout
Standard Plastic Casing 3.34"
Perforated Plastic Casing - 2.75"
Bottom Plug
TYPICAL INCLINOMETER DETAIL
NTS
Top of Fill Surface
Four Lead Pneumatic Piezometer Tubing in Protective Jacket
Bentonite Seal
Select Sand Filter
Slope Indicator (Brand) Pneumatic Piezometer
Varies
TYPICAL PNEUMATIC PIEZOMETER DETAIL
NTS
EMBANKMENT FOUNDATI

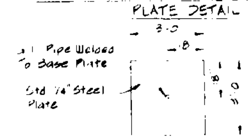




EMBANKMENT FOUNDATION
FOR US PLASTIC TIP PIEZOMETER DETAIL
NTS



EMBANKMENT & FOUNDATION SETTLEMENT
PLATE DETAIL



BASE PLATE DETAIL
NTS

SYMBOL	DESCRIPTION	DATE	APPROVAL

U S ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY H. BENNETT	AQUILLA LAKE AQUILLA CREEK, TEXAS
DRAWN BY E. REED	INSTRUMENTATION PLAN AND DETAILS
REVIEWED BY T. SCHMIDT	
SUBMITTED BY H. E. KARBS, ENGINEER — DATE	INV NO / DATED / DRAWING NUMBER / SHEET NO / SEQUENCE NO

PLATE 28

REFERENCE MARKS

LINE	NO	STATION	OFFSET	REMARKS
A	RM-1	18+00	650' US	
	RM-2	18+00	550 US	
	RM-3	18+00	420' US	
	RM-4	18+00	300 US	
	RM-5	18+00	200' US	
	RM-6	18+00	90' US	
	RM-7	18+00	90' DS	
	RM-8	18+00	200'DS	
	RM-9	18+00	300'DS	
	RM-10	18+00	405' DS	
	RM-11	18+00	480' DS	
	RM-12	18+00	590' DS	
	RM-13	18+00	690' DS	
B	RM-14	25+50	540' US	
	RM-15	25+50	440' US	
	RM-16	25+50	300' US	
	RM-17	25+50	200' US	
	RM-18	25+50	90' US	
	RM-19	25+50	90' DS	
	RM-20	25+50	200 DS	
	RM-21	25+50	300' DS	
	RM-22	25+50	480 DS	
	RM-23	25+50	590' DS	
OUTLET WORKS DISCHARGE CHANNEL *	RM-24	19+50	370' L	
	RM-25	20+50	340' L	
	RM-26	21+50	300' L	
	RM-27	22+50	[illegible]' L	
	RM-28	23+50	260' L	
	RM-29	24+50	250' L	
	RM-30	25+50	265' L	
	RM-31	26+50	250' L	
	DRM-1	1+80	140' DS	DEEP REFERENCE
	DRM-2	[illegible]	110 DS	MARKS INSTALLED
	DRM-3	[illegible]	65 DS	DURING INITIAL CON-
	DRM-4	18+00	637 DS	TRACT DESIGNATED
	DRM-5	18+00	876 DS	AS DRM
	DRM-6	25+44	609 DS	DEEP BENCH MARKS
	DRM-7	25+50	176 DS	INSTALLED DURING
	DRM-8	8+00	719 US	COMPLETION CON-
	DRM-9	18+00	100' US	TRACT DESIGNATED
	DRM-10	25+00	705' US	AS DBM.
	DBM-11	25+80	100 US	
	DRM-12			NOT INSTALLED
	DRM-13			NOT INSTALLED
	DRM-14			NOT INSTALLED
	DBM-17	47+00	610 DS	NOT INSTALLED
	DBM A	75+ 0	510 DS	
	DBM-B	48+50	340' DS	
	DBM-C	34+40	600 DS	

POROUS PLASTIC TIP PIEZOMETERS

LINE	NO	STATION	OFFSET FT	FILTER LOCATION	REMARKS
A	P-1	8 +20	550' U/S	wbn	
	P-2	18 +20	420 U/S	wbn	
	P-3	8 +40	420' U/S	wbn	ABANDONED
	P-4	18 +60	420' U/S	wbn-DR	
	P-5	18 +20	250' U/S	wbn	ABANDONED
	P-6	18 +40	250' U/S	wbn	ABANDONED
	P-7	18 +60	250' U/S	wbn-DR	
	P-8	18 +20	90' U/S	wbn	
	P-9	18 +20	20' U/S	wbn	ABANDONED
	P-10	18 +40	20' U/S	wbn	ABANDONED
	P-11	18 +60	20 U/S	wbn-DR	ABANDONED
	P-12	18 +80	20 U/S	DR	
	P-13	18 +20	90' D/S	wbn	ABANDONED
	P-14	18 +20	250' D/S	wbn	
	P-15	18 +40	250 D/S	wbn-DR	
	P-16	18 +20	405 D/S	wbn	ABANDONED
	P-17	18 +20	550' D/S	wbn	
B	P-18	25 +70	420 U/S	wbn	
	P-19	25 +90	420 U/S	wbn	ABANDONED
	P-20	25 +70	250' U/S	wbn	ABANDONED
	P-21	25 +90	250' U/S	wbn	ABANDONED
	P-22	26 +10	250' U/S	wbn	
	P-23	26 +30	250' U/S	wbn-DR	
	P-24	25 +70	20' U/S	wbn	ABANDONED
	P-25	25 +90	20' U/S	wbn	ABANDONED
	P-26	26 +10	20' U/S	wbn	
	P-27	26 +30	20' U/S	wbn-DR	ABANDONED
	P-28	26 +50	20' U/S	DR	
	P-29	25 +70	90' D/S	wbn	
	P-30	25 +90	90' D/S	wbn	
	P-31	25 +70	250' D/S	wbn	ABANDONED
	P-32	25 +90	250' D/S	wbn	ABANDONED
	P-33	26 +10	250 D/S	wbn	ABANDONED
	P-34	26 +30	250 D/S	wbn-DR	ABANDONED
	P-35	25 +70	405' D/S	wbn	ABANDONED
	P-36	25 +90	405' D/S	wbn	
	P-37	25 +70	590 D/S	wbn	ABANDONED
	P-38	25 +90	590 D/S	wbn	

POROUS PLASTIC TIP PIEZOMETERS

LINE	NO	STATION	OFFSET FT	FILTER LOCATION	REMARKS
C	P-39	40 +60	300 U/S	wbn	[illegible]
	P-40	40 +60	90' U/S	wbn	[illegible]
	P-41	40 +60	20' D/S	wbn	[illegible]
	P-42	40 +20	90 D/S	wbn	[illegible]
	P-43	40 +60	250 D/S	wbn	[illegible]
	P-44	40 +[illegible]	400' D/S	wbn	[illegible]
	P-45	40 +[illegible]	400 D/S	wbn	[illegible]
D	P-46	47 +20	360 US	OVB	
	P-47	47 +40	360 US	wbn	
	P-48	47 +60	360 US	wbn-DR	
	P-49	47 +20	90 US	wbn DR	
	P-50	47 +20	20 DS	OVB	
	P-51	47 +40	20 DS	wbn-DR	
	P-52	47 +60	20 DS	DR	
	P-53	47 +20	90 DS	wbn DR	
	P-54	47 +[illegible]	445 DS	OVB	
	P-55	47 +[illegible]	445 DS	wbn	
	P-56	47 +60	445 DS	wbn DR	
	P-57	47 +20	500 DS	wbn	
	P-58	47 +40	500 DS	wbn	
	P-59	47 +60	500 DS	wbn-DR	
E	P-60	53 +40	540 US	wbn	[illegible]
	P-61	53 +40	580 US	wbn	
	P-62	53 +40	250 US	wbn	
	P-63	53 +40	[illegible] US	wbn	
	P-64	53 +40	[illegible] DS	wbn	
	P-65	53 +20	20 DS	DR	
	P-66	53 +40	90 DS	wbn	
	P-67	53 +40	250 DS	wbn	
	P-68	53 +40	375 DS	wbn	
	P-69	53 +40	5[illegible]	wbn	
F	P-70	[illegible] +50	[illegible] DS	OVB	SEE [illegible]
	P-71	[illegible] +75	330 DS	OVB	
	P-72	[illegible] +20	20 DS	OVB	
D	P-73	47 +40	20 DS	DR	
	P-74	47 +60	[illegible] DS	DR	
	P-75	47 +[illegible]	250 DS	DR	
A-1	P A	17 +00	20 US	wbn	[illegible]
	P B	17 +[illegible]	90 DS	wbn	
A-2	P C	20 +50	20 US	wbn	
	P D	20 +50	90 DS	wbn	
B	P E	24 +50	20 US	wbn	[illegible]

NOTE: OPEN SYSTEM PIEZOMETERS [illegible] WELL POINTS RATHER THAN POROUS [illegible]

SETTLEMENT PLATES

LINE	NO	STATION	OFFSET	ORIG PLATE EL	REMARKS
A	SP-1	17+40	90' US	518 346	SETTLEMENT PLATES IN-
	SP-2	17+40	90' DS	517 182	STALLED ON
B	SP-3	24+70	90' US	532 815	PREPARED
	SP-4	24+70	90' DS	530 425	FOUNDATION
D	SP-5	47+50	90' US	505 14	
	SP-6	47+50	90' DS	501 67	

INCLINOMETERS

LINE	NO	STATION	OFFSET	AT FROM ELEVATION	REMARKS
A	I-1	17 +80	300 US	EL 4[illegible]	
	I-2	17 +80	90 US	EL 4[illegible]	
	I-3	17 +80	9[illegible]	EL 44[illegible]	
	I-4	17 +80	[illegible]	EL 44[illegible]	
	I-5	17 +80	480 [illegible]	EL 45[illegible]	
B	I-6	25 +30	[illegible]	EL 4[illegible]	
	I-7	25 +30	9[illegible]	EL 44[illegible]	
	I-8	25 +30	[illegible]	EL 44[illegible]	
	I-9	25 +30	[illegible] DS	EL 4[illegible]	
	I-10	25 +30	480 DS	EL 44[illegible]	
OUTLET WORKS	I-11	[illegible]	[illegible]	EL 45[illegible]	[illegible]
	I-12	22 +00	29[illegible]	EL 449[illegible]	[illegible]
D	I-13	47 +50	520 US	EL 45[illegible]	
	I-14	46 +80	90 US	EL [illegible]	
	I-15	46 +80	90 DS	EL 435	
	I-16	46 +80	520 DS	EL 44[illegible]	

POROUS PLASTIC TIP PIEZOMETERS

LINE	NO.	STATION	OFFSET FT	FILTER LOCATION	REMARKS
	P-39	40+?0	300 US	wbn	ABANDONED
	P-40	40+?0	90 U/S	wbn	ABANDONED
	P-41	40+?0	20 D/S	wbn	ABANDONED
	P-42	40+?0	90 D/S	wbn	ABANDONED
	P-43	4?+?0	250 D/S	wbn	ABANDONED
	P-44	4?+?0	400 D/S	wbn	ABANDONED
	P-45	4?+?0	400 DS	wbn	ABANDONED
	P-46	47+20	360 US	OVB	
	P-47	47+40	360 US	wbn	
	P-48	47+?0	360 US	wbn-DR	
	P-49	47+20	90 US	wbn-DR	
	P-50	47+20	20 DS	OVB	
	P-51	47+4?	20 DS	wbn-DR	
	P-52	47+20	20 DS	DR	
	P-53	47+20	90 DS	wbn-DR	
	P-54	47+2?	345 DS	OVB	
	P-55	47+?	345 DS	wbn	
	P-56	47+60	345 DS	wbn-DR	
	P-57	47+20	500 DS	wbn	
	P-58	47+40	500 DS	wbn	
	P-59	47+40	500 DS	wbn-DR	
E	P-60	53+40	540 US	wbn	ABANDONED
	P-61	53+40	550 US	wbn	
	P-62	53+40	250 US	wbn	
	P-63	53+40	90 US	wbn	
	P-64	53+40	20 DS	wbn	
	P-65	53+20	20 DS	DR	
	P-66	53+40	90 DS	wbn	
	P-67	53+40	250 DS	wbn	
	P-68	53+40	375 DS	wbn	
	P-69	53+40	515 US	wbn	
F	P-70	??+50	40 DS	OVB	SEEPAGE PIEZOMETERS AT OUTLET WORKS
	P-71	?7+75	330 DS	OVB	
	P-72	?9+?0	20 DS	OVB	
	P-73	47+60	20 US	DR	
	P-74	47+60	90 DS	DR	
	P-75	47+60	250 DS	DR	
A_1	P-A	17+00	20 US	wbn	
	P-B	17+20	90 DS	wbn	ABANDONED
A_2	P-C	20+00	20 US	wbn	
	P-D	20+50	90 DS	wbn	
B_1	P-E	24+50	20 US	wbn	ABANDONED

NOTE: OPEN SYSTEM PIEZOMETERS P-A THRU P-E HAVE METAL WELL POINTS RATHER THAN POROUS PLASTIC TIPS

PNEUMATIC PIEZOMETERS

LINE	NO.	STATION	OFFSET FT	ZONE	REMARKS
A	PP-1	?+60	250 U/S	Wavy Wbn	ABANDONED
	PP-2	?+60	20 U/S	Wavy Wbn	ABANDONED
	PP-3	?+80	20 U/S	Wbn-DR	ABANDONED
	PP-4	17+60	90 D/S	Wavy Wbn	ABANDONED
	PP-5	17+60	250 D/S	Wavy Wbn	ABANDONED
	PP-6	17+60	405 D/S	Wavy Wbn	ABANDONED
A_1	PP-7	17+20	90 U/S	Wavy Wbn	ABANDONED
	PP-8	17+20	20 U/S	Wavy Wbn	ABANDONED
	PP-9	17+20	90 D/S	Wavy Wbn	
	PP-10	17+20	250 D/S	Wavy Wbn	
A_2	PP-11	21+00	250 U/S	Wavy Wbn	ABANDONED
	PP-12	21+00	90 U/S	Wavy Wbn	ABANDONED
	PP-13	21+00	20 U/S	Wavy Wbn	ABANDONED
	PP-14	21+00	90 D/S	Wavy Wbn	
	PP-15	21+00	250 D/S	Wavy Wbn	
	PP-16	21+00	405 D/S	Wavy Wbn	
B_1	PP-17	25+10	20 D/S	Wavy Wbn	ABANDONED
	PP-18	26+10	405 D/S	Wavy Wbn	ABANDONED
C	PP-19	41+00	20 D/S	Wavy Wbn	ABANDONED
	PP-20	41+00	90 D/S	Wavy Wbn	ABANDONED
	PP-21	41+00	250 D/S	Wavy Wbn	ABANDONED
	PP-22	41+00	400 D/S	Wavy Wbn	ABANDONED
D	PP-23	47+00	20 D/S	Wbn	ABANDONED
	PP-24	47+00	40 D/S	Ovb Sd	ABANDONED
	PP-25	47+00	250 D/S	DR	
	PP-26	47+00	270 D/S	Ovb Sd	ABANDONED

INCLINOMETERS

LINE	NO.	STATION	OFFSET	BOTTOM ELEVATION	REMARKS
A	I-1	17+80	300 US	EL 465.1	
	I-2	?+80	90 US	EL 464.6	
	I-3	?+80	90 DS	EL 459.0	
	I-4	17+80	300 DS	EL 464.9	ABANDONED
	I-5	?+80	480 DS	EL 456.0	
B	I-6	25+30	300 US	EL 452.6	
	I-7	25+30	90 US	EL 455.5	
	I-8	25+30	90 DS	EL 458.9	
	I-9	25+30	300 DS	EL 461.0	ABANDONED
	I-10	25+30	480 DS	EL 454.5	
OUTLET WORKS	I-11	22+00	140 L	EL 450.2	ABANDONED
	I-12	22+00	290 L	EL 449.7	ABANDONED
	I-3	47+50	520 US	EL 455.4	
	I-4	46+80	90 US	EL 436.6	
	I-5	46+80	90 DS	EL 435.0	
	I-6	46+90	500 DS	EL 438.7	

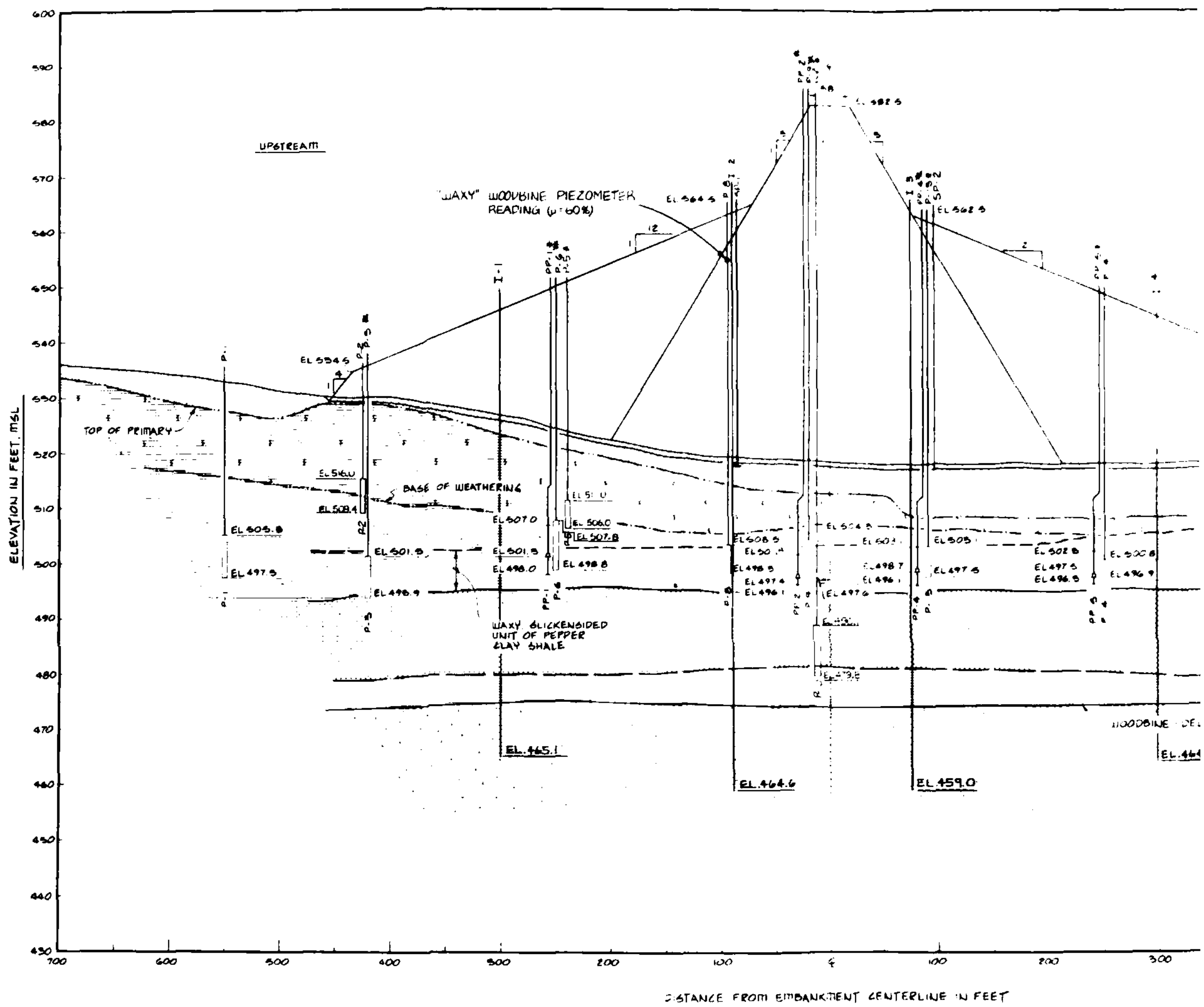
NOTE
wbn - - - - WOODBINE FORMATION
DR - - - - DEL RIO FORMATION
wbn-DR - - CONTACT BETWEEN WOODBINE AND DEL RIO FORMATION
OVB - - - OVERBURDEN
Sd - - - - SAND

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY: [illegible]
DRAWN BY: [illegible]
REVIEWED BY: T. SCHMIDT

AQUILLA LAKE
AQUILLA CREEK, TEXAS
SCHEDULE OF INSTRUMENTATION

SUBMITTED BY: [illegible]
ENGINEER | DATE
INV NO | DATED | DRAWING NUMBER | SHEET NO. | SEQUENCE NO.



INSTRUMENTATION LINE A

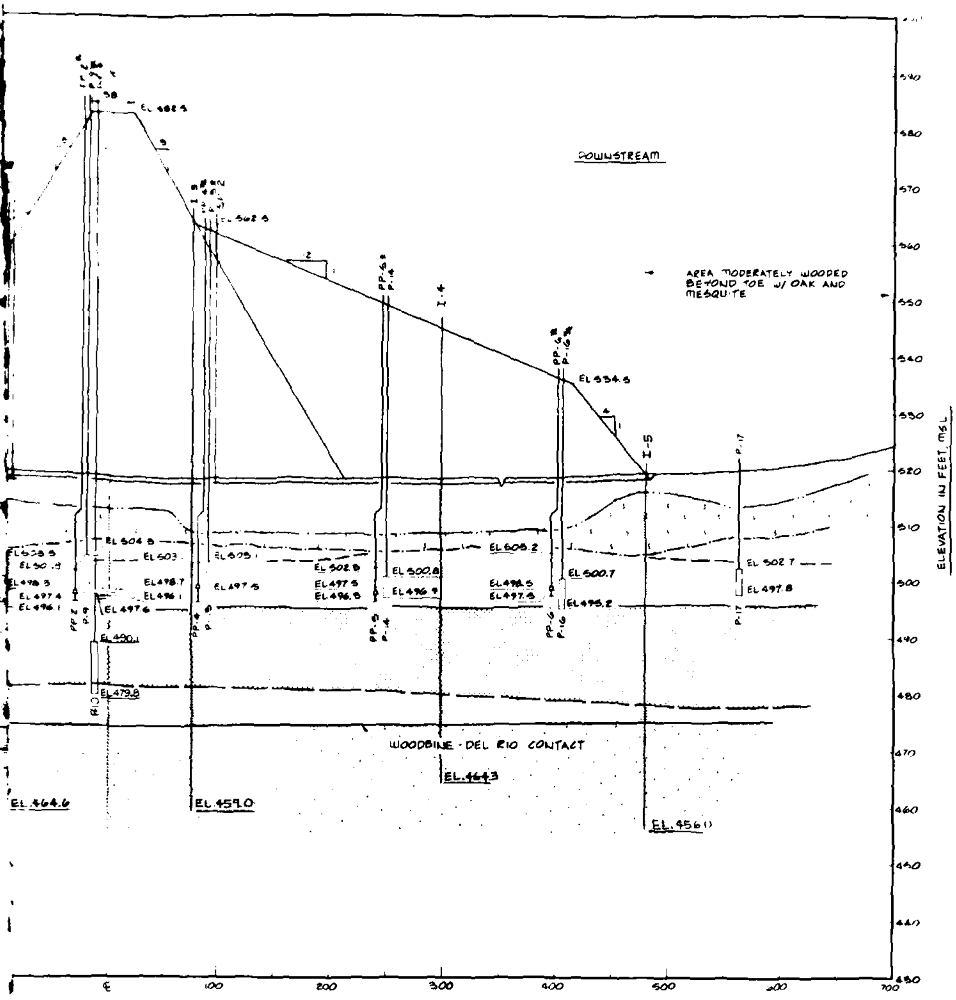
STATION 1+40 TO STATION 8+40

LEGEND

- OVERBURDEN
- WEATHERED WOODBINE (PEPPER) CLAY SHALE
- WOODBINE (PEPPER) CLAY SHALE
- WOODBINE SANDSTONE
- DEL RIO SHALE
- EL / EL — POROUS PLASTIC TIP PIEZOMETER SHOWING VERTICAL LIMITS OF SAND FILTER
- EL / EL / EL — PNEUMATIC PIEZOMETER SHOWING VERTICAL LIMITS OF SAND FILTER AND LOCATION OF BOTTOM OF TRANSDUCER

NOTES

1. THE GROUND LINE TAKEN AT STATI
2. ABANDONED PIE ASTERISK (*)
3. SETTLEMENT PLA INCLINOMETERS
4. MAXIMUM PIEZOM RECORDED AND PERCENT PORE



VERT SCALE 1" = 10'-0

HORIZ SCALE 1" = 50'-0

...OM EMBANKMENT CENTERLINE IN FEET

...NSTRUMENTATION LINE A

...ON 17+40 TO STATION 8+40

NOTES:

1. THE GROUND LINE FOR THIS SECTION WAS TAKEN AT STATION 18+40
2. ABANDONED PIEZOMETERS INDICATED BY ASTERISK (*)
3. SETTLEMENT PLATES 1,2 ARE AT 17+40 INCLINOMETERS 1,2,3,4,5 ARE AT 17+80.
4. MAXIMUM PIEZOMETRIC ELEVATION RECORDED AND CORRESPONDING PERCENT PORE PRESSURE (u = %)

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

BRAZOS RIVER BASIN TEXAS
AQUILLA LAKE
AQUILLA CREEK, TEXAS

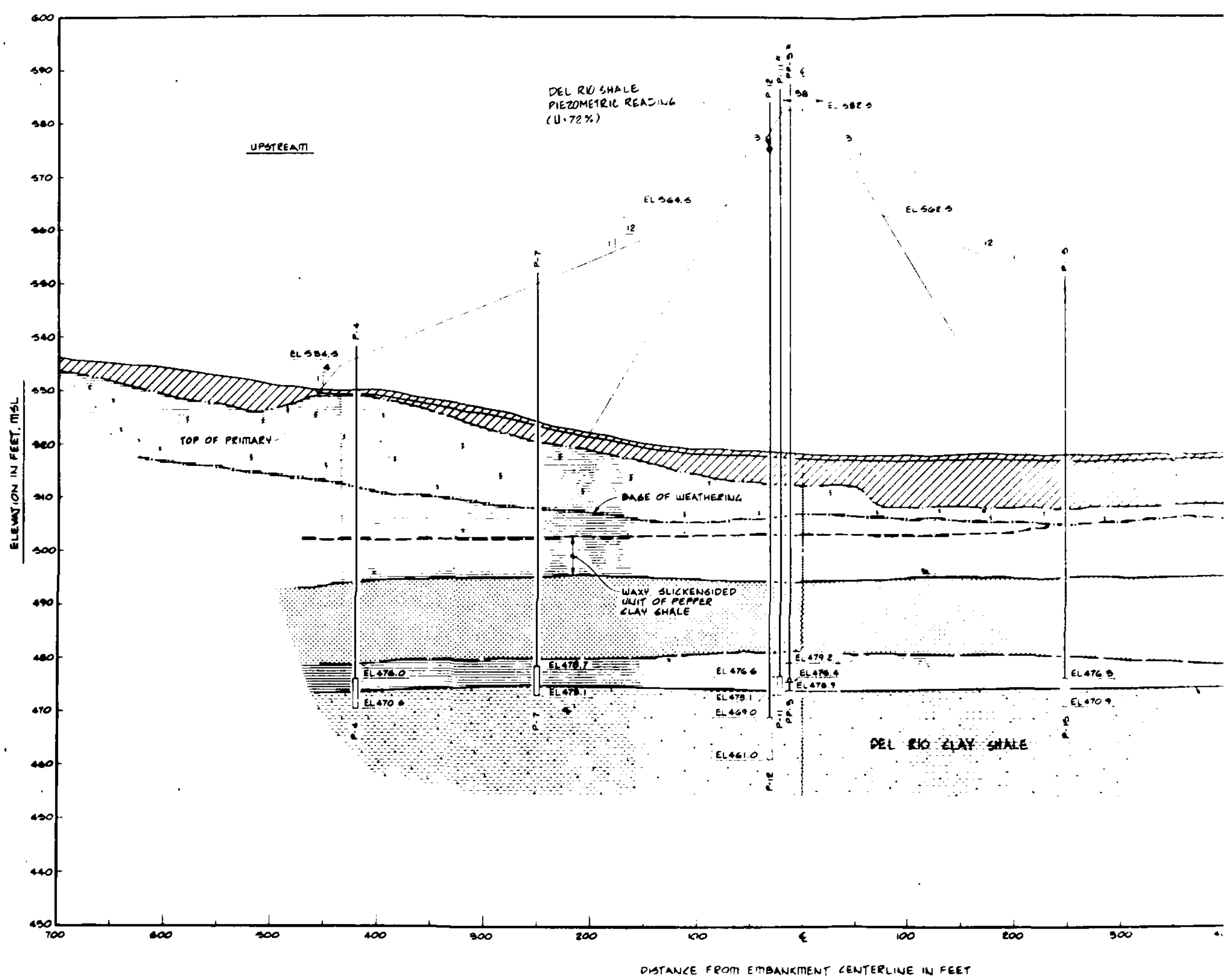
INITIAL EMBANKMENT
INSTRUMENTATION
LINE A

DESIGNED BY: W. NICHOLS, A. BRAUCH
DRAWN BY: E.L. HILL
CHECKED BY: N. BRUNETT, T. SCHMIDT

H.E. KARBS

INV NO.
DATED
DRAWING NUMBER
SHEET NO.

PLATE 30



INSTRUMENTATION LINE A

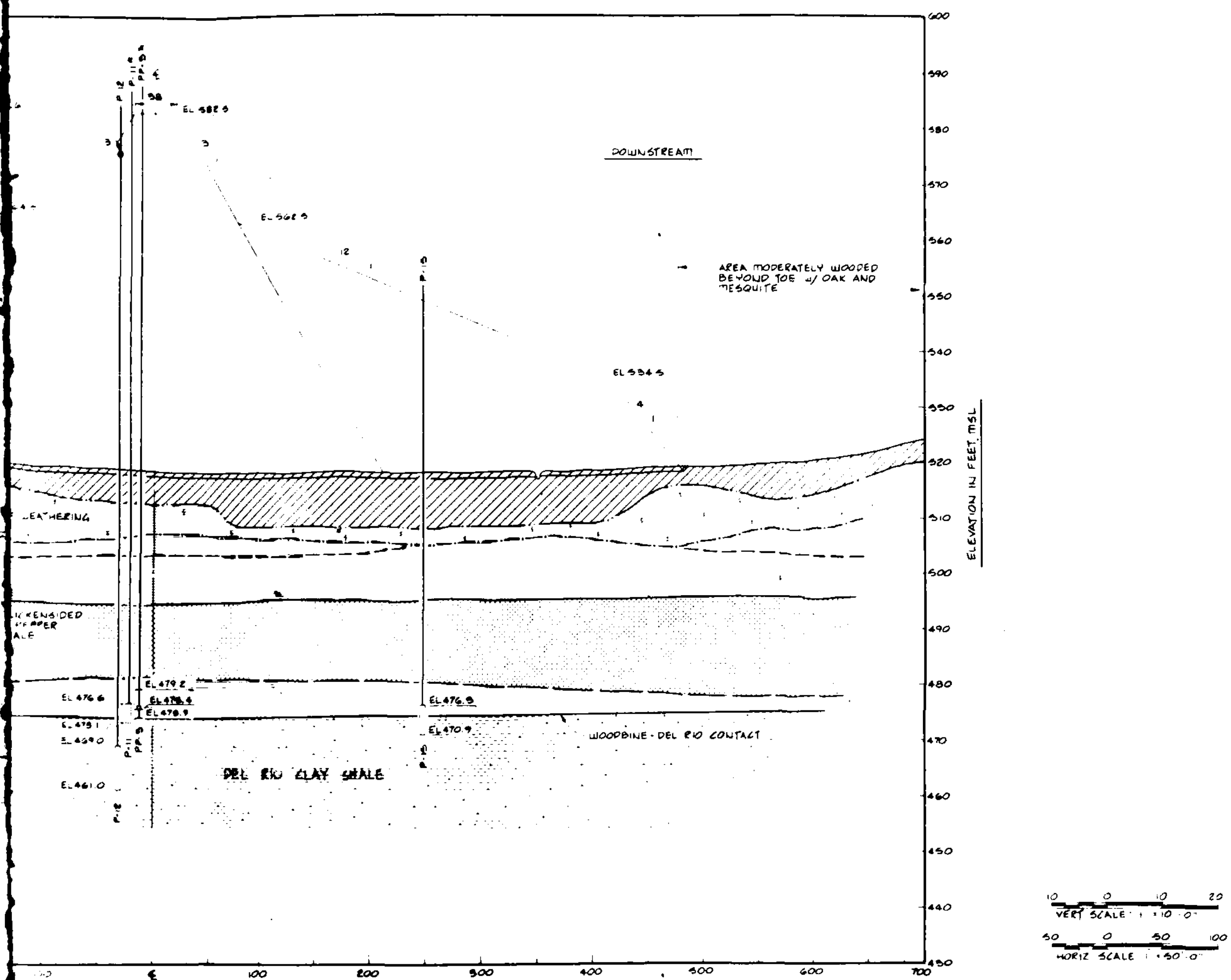
STATION 18+20 TO STATION 19+00

LEGEND

- OVERBURDEN
- WEATHERED WOODBINE (PEPPER) CLAY SHALE
- WOODBINE (PEPPER) CLAY SHALE
- WOODBINE SANDSTONE
- DEL RIO SHALE
- POROUS PLASTIC TIP PIEZOMETER SHOWING VERTICAL LIMITS OF SAND FILTER
- PNEUMATIC PIEZOMETER SHOWING VERTICAL LIMITS OF SAND FILTER AND LOCATION OF BOTTOM OF TRANSDUCER.

NOTE:

1. THE GROUND LINE FOR THIS ... AT STATION 18+40
2. * ABANDONED PIEZOMETER ...
3. PIEZOMETER LEVELS SHOWN ... READINGS RECORDED
4. PERCENT PORE PRESSURES ... TO MAXIMUM PIEZOMETER ...



...NCE FROM EMBANKMENT CENTERLINE IN FEET

INSTRUMENTATION LINE A

STATION 8+20 TO STATION 19+00

NOTE:

1 THE GROUND LINE FOR THIS SECTION WAS TAKEN AT STATION 18+40
2 ABANDONED PIEZOMETER INDICATED BY ASTERISK (*)
3 PIEZOMETER LEVELS SHOWN ARE FOR THE MAXIMUM READINGS RECORDED
4 PERCENT PORE PRESSURES (U%) SHOWN CORRESPOND TO MAXIMUM PIEZOMETER READING.

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

BRAZOS RIVER BASIN, TEXAS
AQUILLA LAKE
AQUILLA CREEK, TEXAS

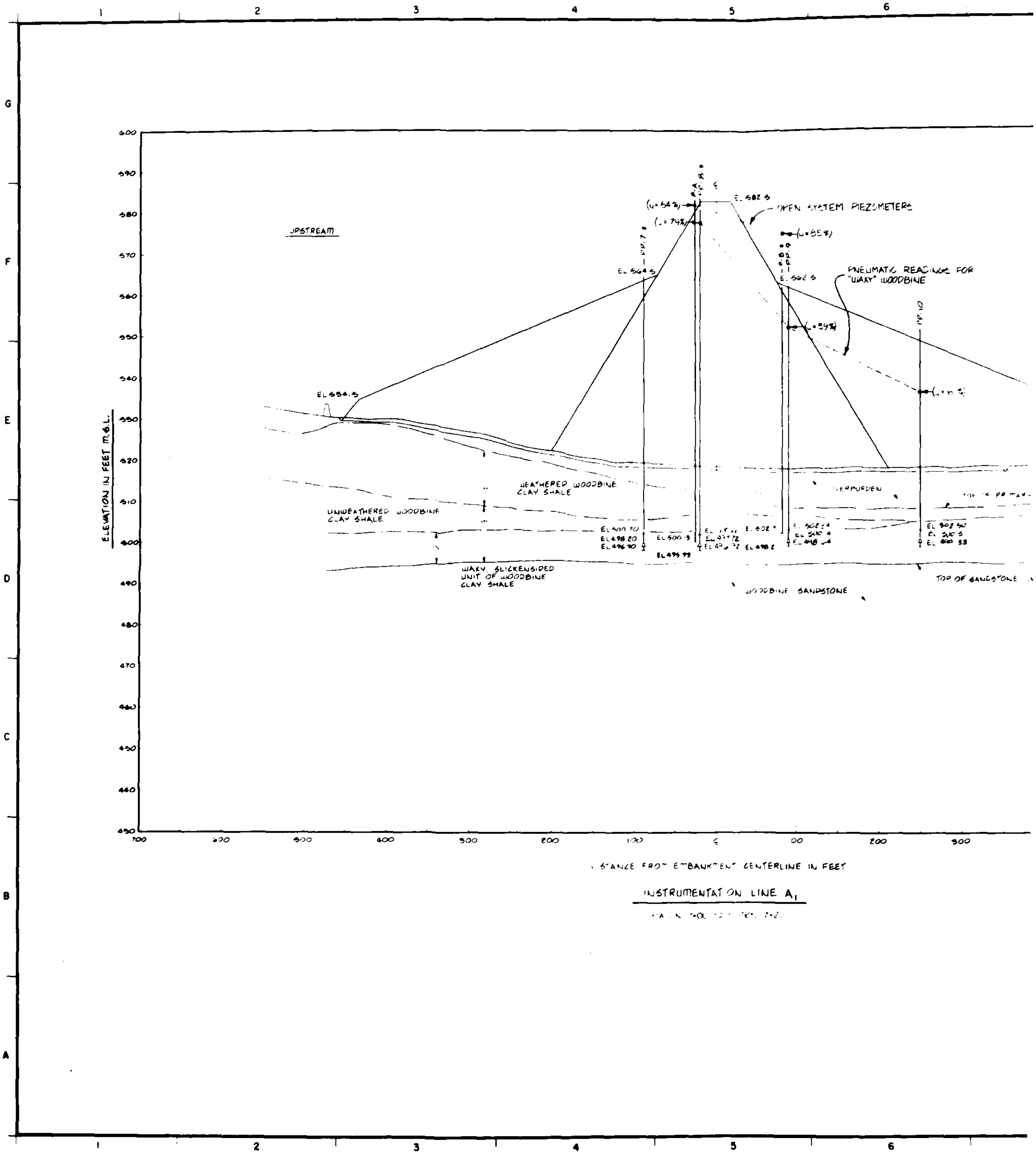
INITIAL EMBANKMENT
PIEZOMETER SECTION
LINE A

DESIGNED BY: W NICHOLS, A BEACH
DRAWN BY: R L HILL
CHECKED BY: T SCHMIDT, N BENNETT

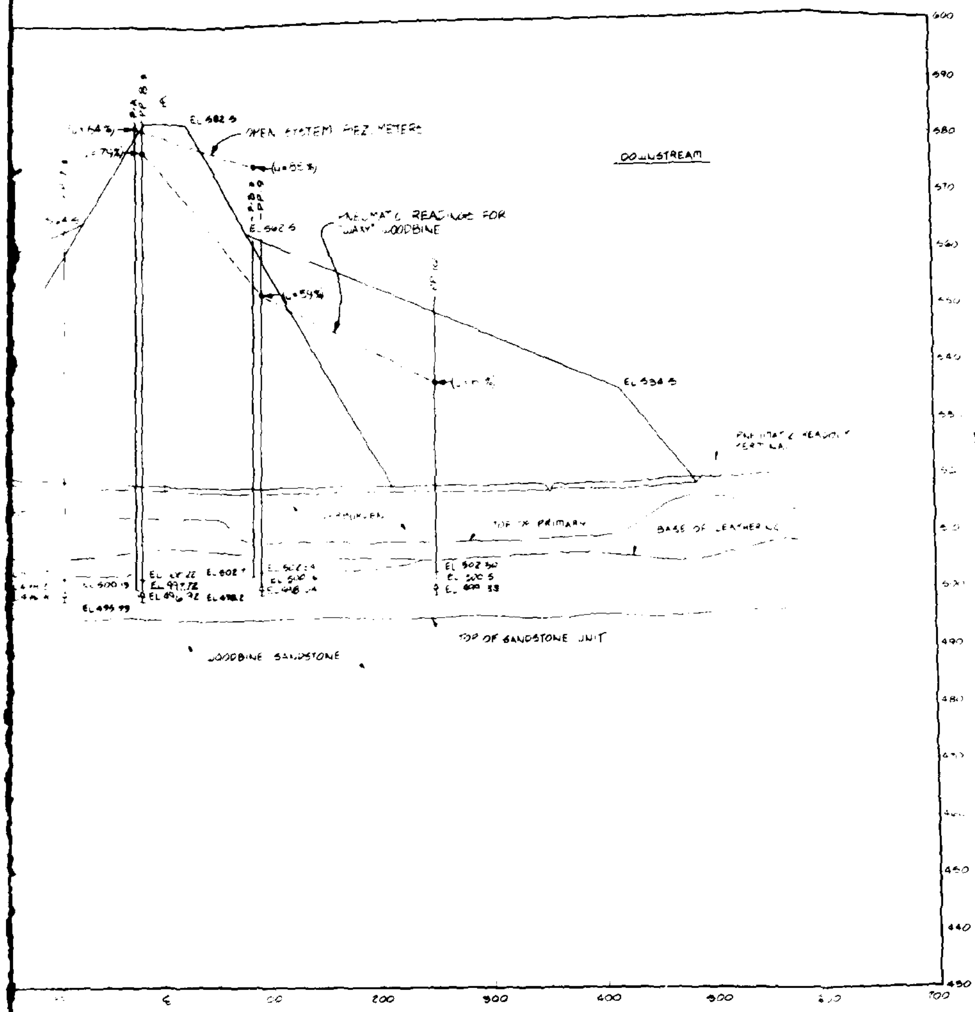
H.E. KARBS

INV NO
DATED
DRAWING NUMBER
SHEET NO

PLATE 31



INSTRUMENTATION LINE A_1



FROM EMBANKMENT CENTERLINE IN FEET

INSTRUMENTATION LINE A₁

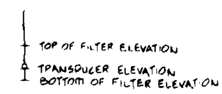
NOTES

1. THE GROUND LINE FOR THIS SECTION WAS TAKEN AT STATION 18+60
2. ABANDONED PIEZOMETER INDICATED BY ASTERISK (*)
3. MAXIMUM PIEZOMETRIC ELEVATION RECORDED AND CORRESPONDING PERCENT PORE PRESSURE (u%)

VERT SCALE

HORIZ SCALE

SCALE IN FEET



PNEUMATIC PIEZOMETER

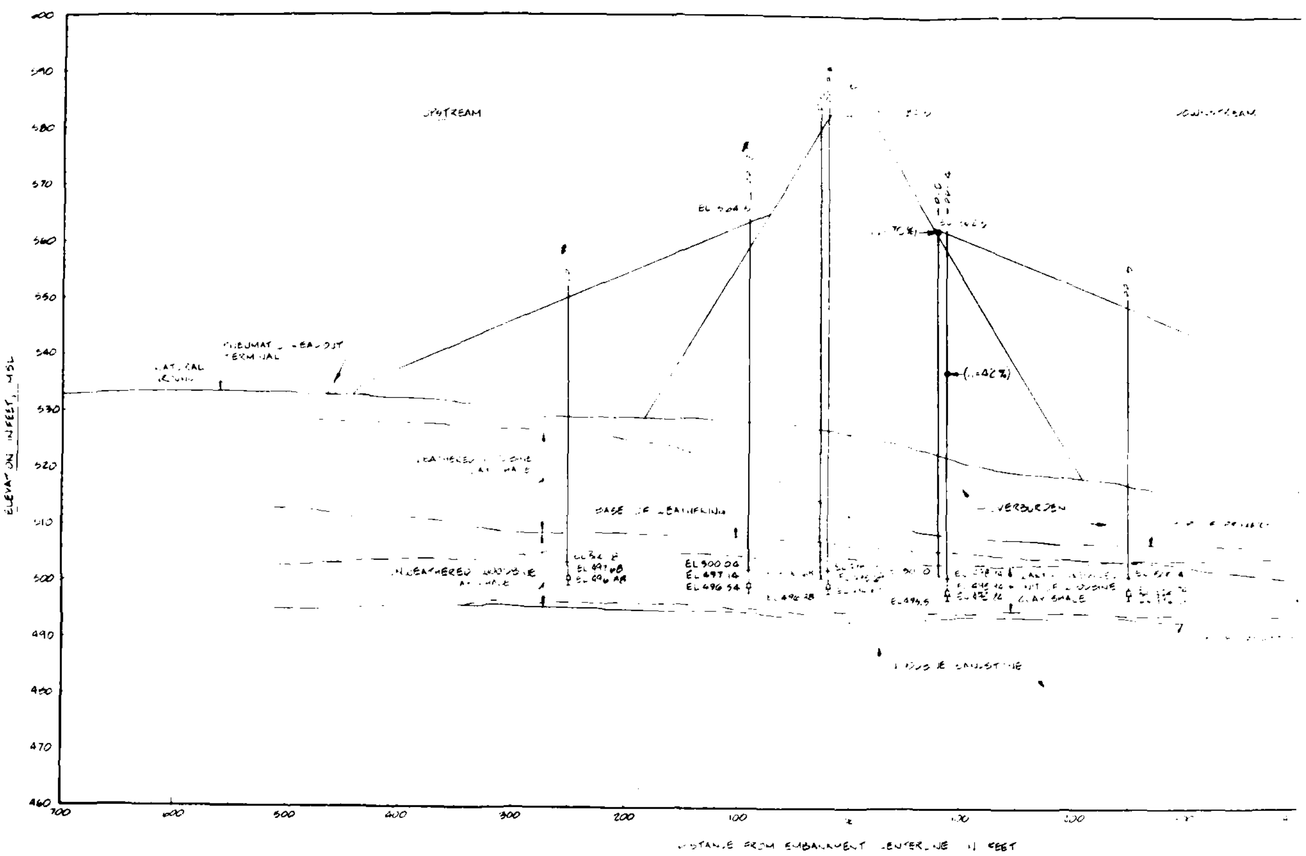
U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

AQUILLA LAKE
AQUILLA CREEK, TEXAS
INITIAL EMBANKMENT
PIEZOMETER SECTION
LINE A₁

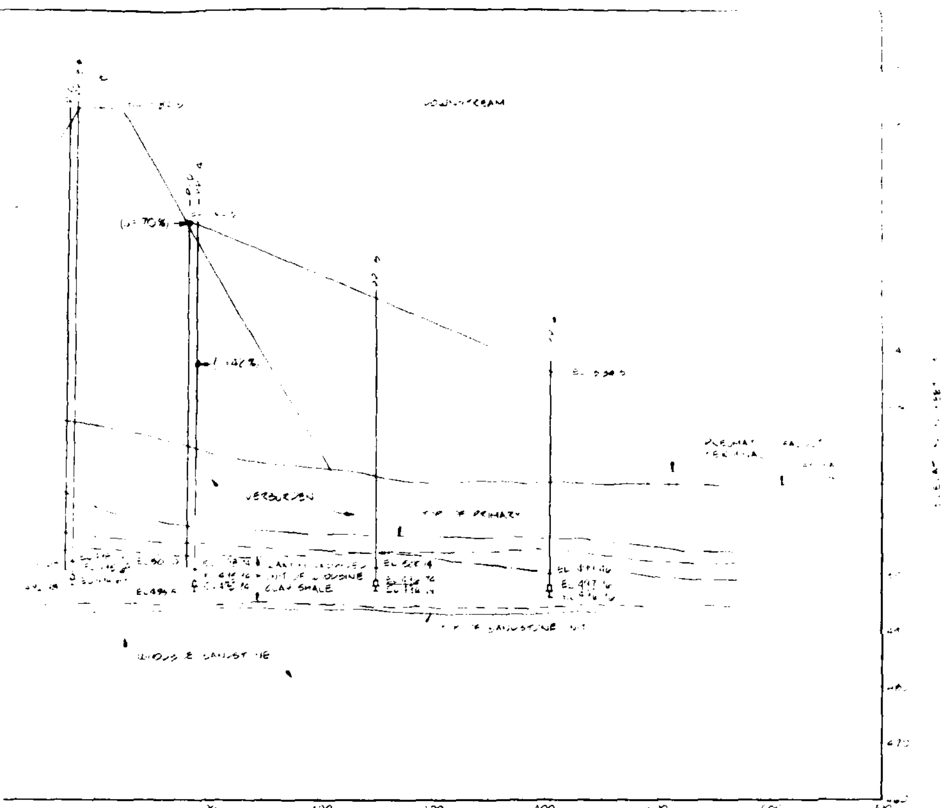
DESIGNED BY W. NICHOLS, A. BRAUCH
DRAWN BY R. HILL
CHECKED BY J. BENNETT, T. SCHMIDT
H.E. KARBS

INV NO
DATED
DRAWING NUMBER
SHEET NO
OF

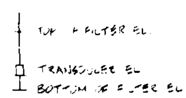
PLATE 32



INSTRUMENTATION LINE A_2



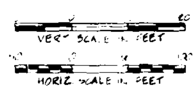
INSTRUMENTATION LINE A_2



PNEUMATIC PIEZOMETER

ABANDONED PIEZOMETER INDICATED ... ASTERISK (*)

3 ... AND CORRESPONDING PERCENT PORE PRESSURE (u%)



SYMBOL NO.	ACTION	DATE	DESCRIPTION OF REVISION

U S ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY

DRAWN BY

CHECKED BY

INITIAL EMBANKMENT

PIEZOMETER SECTION

INV NO

DATED

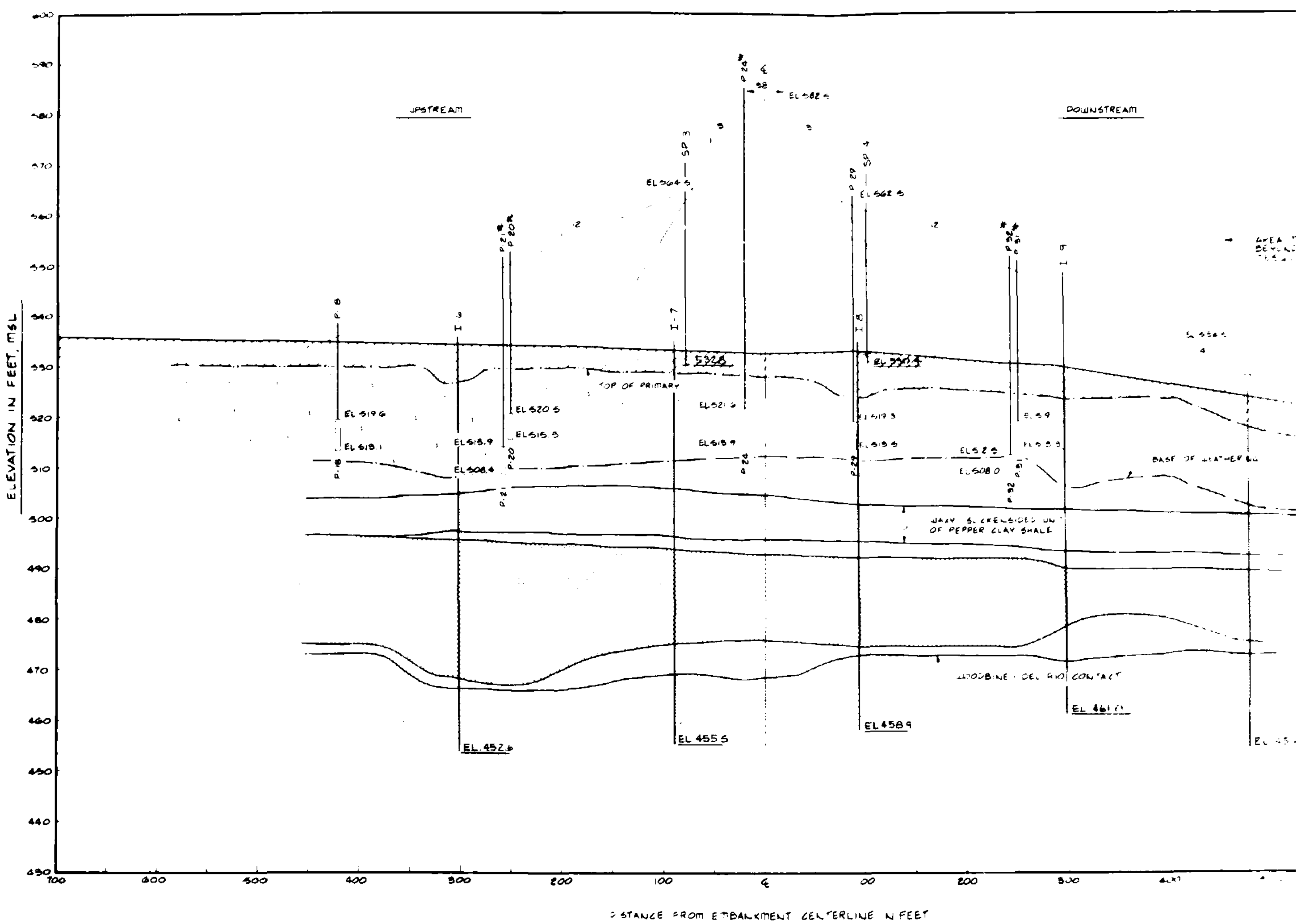
DRAWING NUMBER

SHEET NO 3 OF 4

SEQUENCE NO 3

H.E. KARBS

PLATE 33

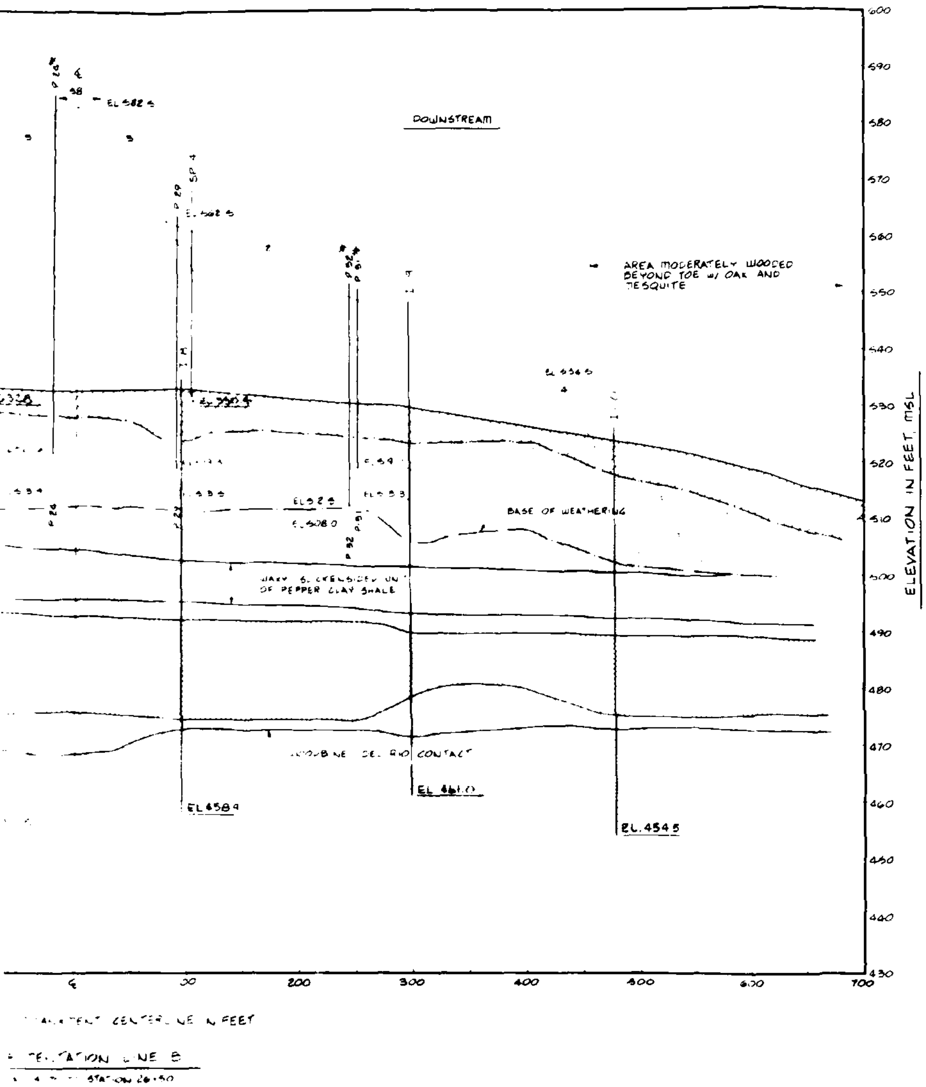


INSTRUMENTATION LINE B

STATION 24+70 TO STATION 26+50

LEGEND

- OVERBURDEN
- WEATHERED WOODBINE (PEPPER) CLAY SHALE
- WOODBINE (PEPPER) CLAY SHALE
- WOODBINE SANDSTONE
- DEL RIO SHALE
- POROUS PLASTIC TIP PIEZOMETER SHOWING VERTICAL LIMITS OF SAND FILTER



NOTES:

1. THE GROUND LINE FOR THIS SECTION WAS TAKEN AT STATION 25+90.
2. ABANDONED PIEZOMETERS INDICATED BY ASTERISK (*)
3. SETTLEMENT PLATES 3,4 ARE AT STATION 24+70
4. INCLINOMETERS 6,7,8,9,10 ARE AT STATION 25+30

VERT SCALE 1" = 10'-0"

HORIZ SCALE 1" = 50'-0"

U S ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

BRAZOS RIVER BASIN, TEXAS
AQUILLA LAKE
AQUILLA CREEK, TEXAS

INITIAL EMBANKMENT

INSTRUMENTATION
LINE B

DESIGNED BY W. NICHOLS, A. BRANCH

DRAWN BY R. CHILL

CHECKED BY W. BENNETT, T. SCHMIDT

H.E. KARBE

INV NO

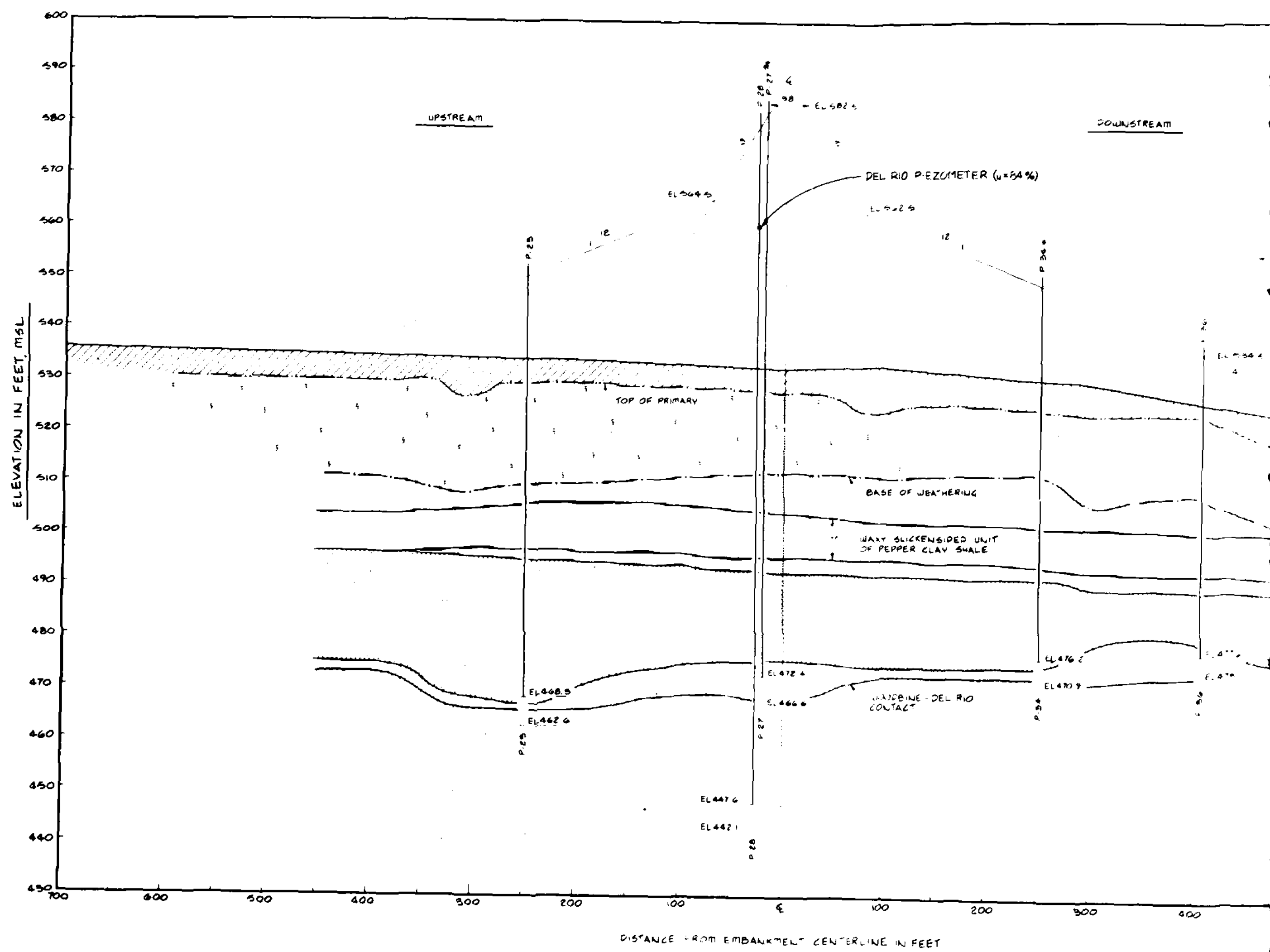
DATED

DRAWING NUMBER

SHEET NO OF

SEQUENCE NO.

PLATE 34

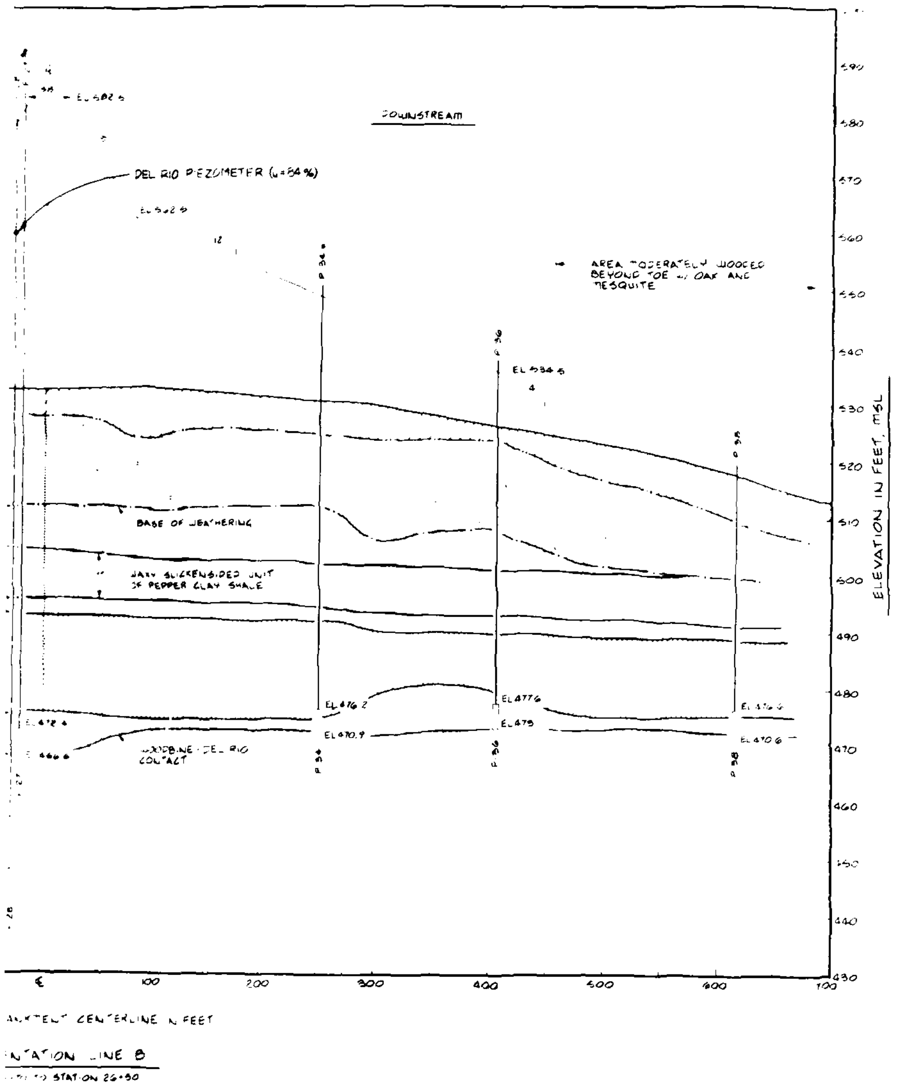


INSTRUMENTATION LINE B

STATION 25+70 TO STATION 26+50

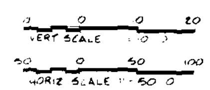
LEGEND

- OVERBURDEN
- WEATHERED WOODBINE (PEPPER) CLAY SHALE
- WOODBINE (PEPPER) CLAY SHALE
- WOODBINE SANDSTONE
- DEL RIO SHALE
- POROUS PLASTIC TIP PIEZOMETER SHOWING VERTICAL LIMITS OF SAND FILTER



NOTES:

1. THE GROUND LINE FOR THIS SECTION WAS TAKEN AT STATION 25+90
2. ABANDONED PIEZOMETERS INDICATED BY ASTERISK (*)
3. MAXIMUM PIEZOMETRIC ELEVATION RECORDED AND CORRESPONDING PERCENT PORE PRESSURE (u=%)



U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH TEXAS

BRAZOS RIVER BASIN, TEXAS
AQUILLA LAKE
AQUILLA CREEK, TEXAS

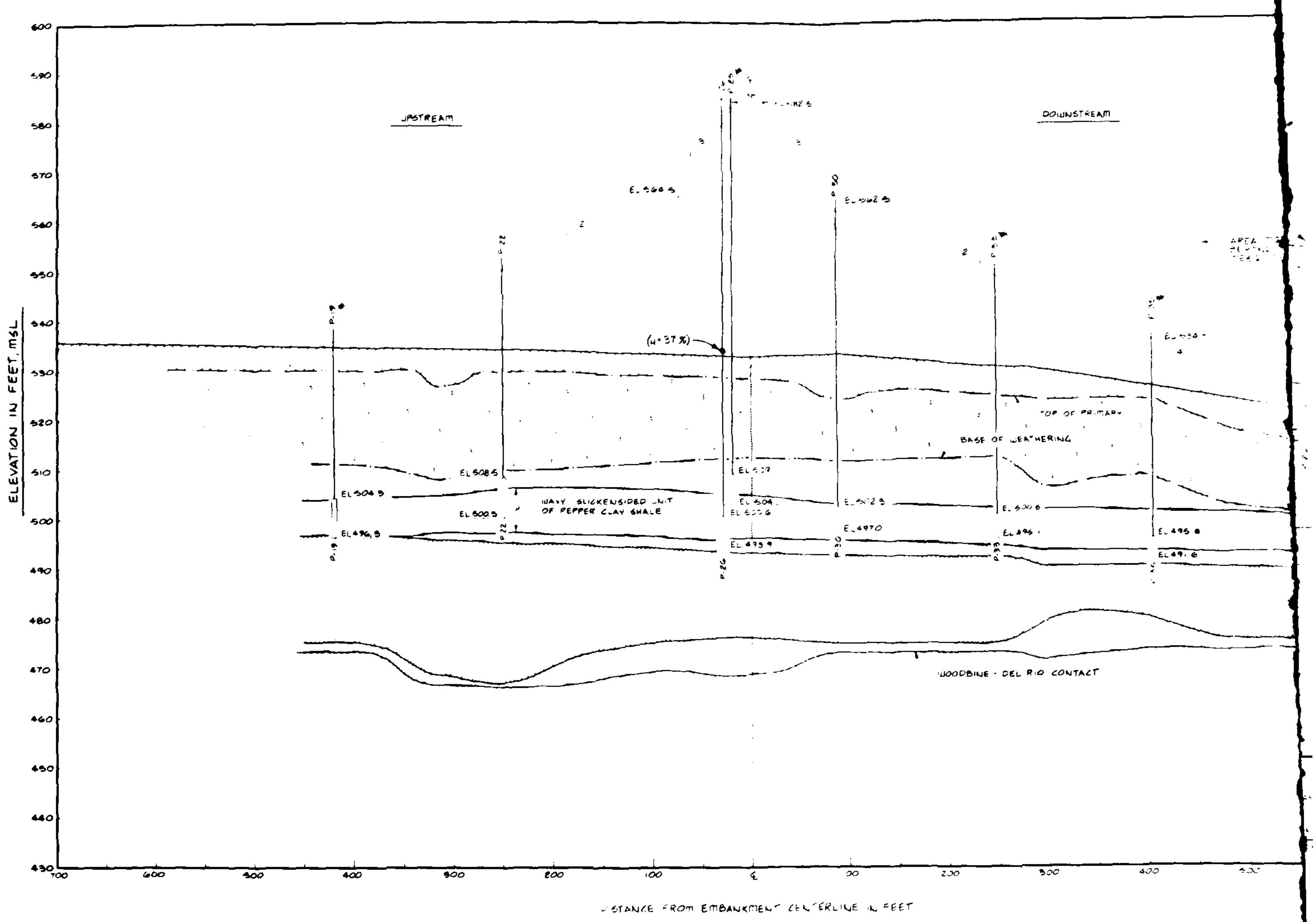
INITIAL EMBANKMENT
PIEZOMETER SECTION

LINE B

DESIGNED BY	W. NICHOLS, A. BRANCH
DRAWN BY	R. HILL
CHECKED BY	W. BENNETT, T. SCHMIDT
INV NO	
DATED	
DRAWING NUMBER	
SHEET NO	OF
SEQUENCE NO	

H. E. KARBS

PLATE 35

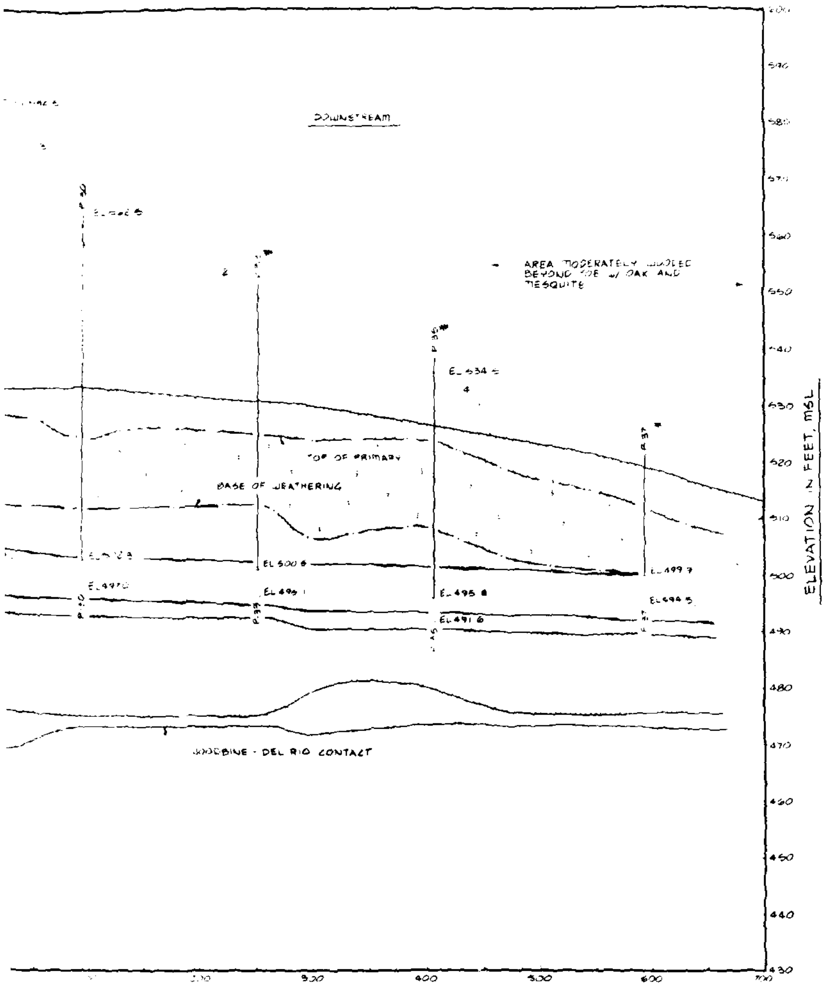


INSTRUMENTATION LINE B

STATION 25+70 TO STATION 26+50

LEGEND

- OVERBURDEN
- WEATHERED WOODBINE (PEPPER) CLAY SHALE
- WOODBINE (PEPPER) CLAY SHALE
- WOODBINE SANDSTONE
- DEL RIO SHALE
- EL / EL — POROUS PLASTIC TIP PIEZOMETER SHOWING VERTICAL LIMITS OF SAND FILTER.



NOTE

1. THE GROUND LINE FOR THIS SECTION WAS TAKEN AT STATION 25+90.
2. ABANDONED PIEZOMETERS INDICATED BY ASTERISK (*)
3. MAXIMUM PIEZOMETRIC ELEVATION RECORDED AND CORRESPONDING PERCENT PORE PRESSURE (u %)

VERT SCALE

HORIZ SCALE

SYMBOL	ACTION	DATE	DESCRIPTION OF REVISION

U S ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY W. NICHOLS, A. BRALICH
DRAWN BY R. L. HILL
CHECKED BY L. BENNETT, T. SCHMIDT

BRAZOS RIVER BASIN, TEXAS
AQUILLA LAKE
AQUILLA CREEK, TEXAS

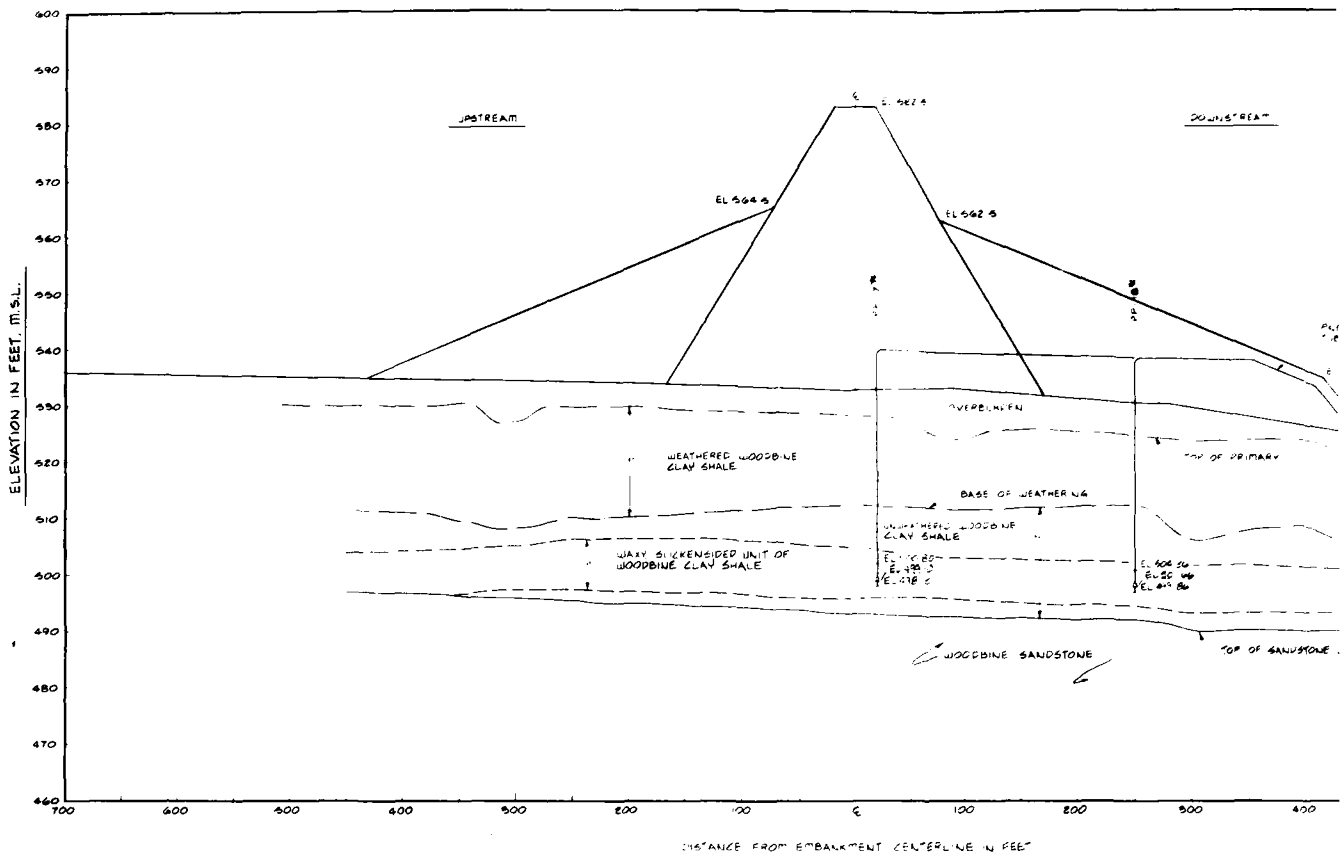
INITIAL EMBANKMENT
PIEZOMETER SECTION

LINE P

H.E. KARBS

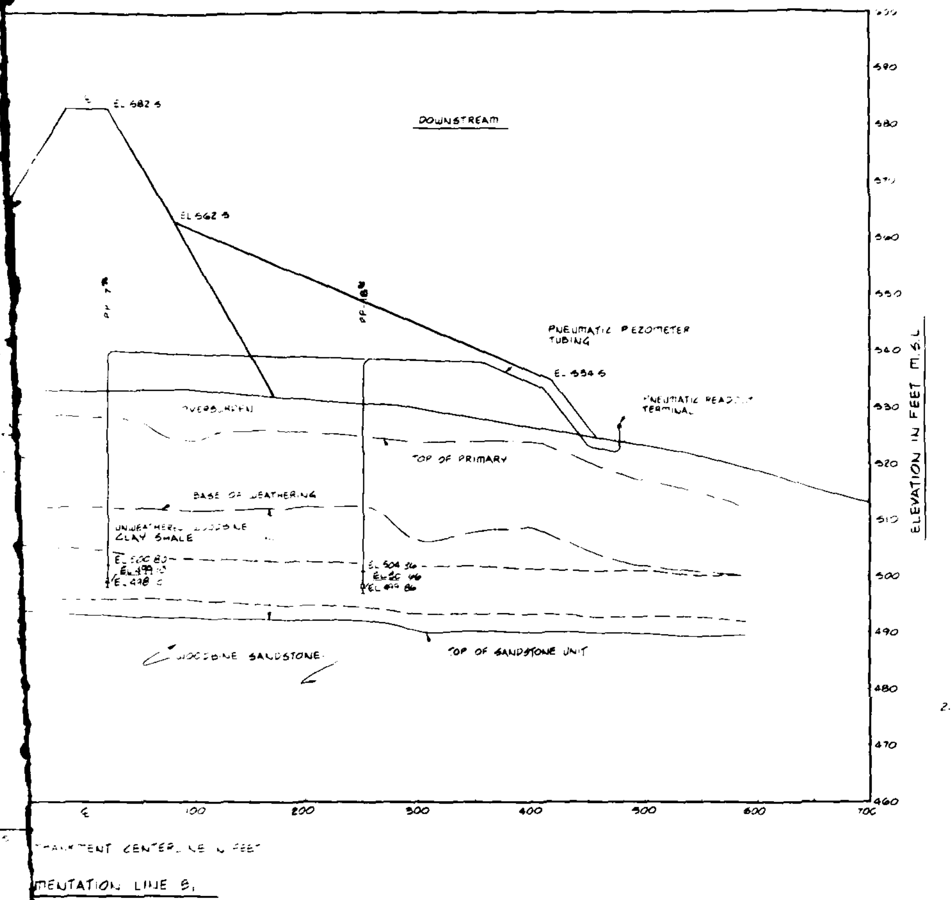
INV NO
DATED
DRAWING NUMBER
SHEET NO OF
SEQUENCE NO.

PLATE 36



INSTRUMENTATION LINE B_1

STATION 25+10



NOTES

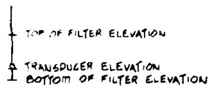
THE GROUND LINE FOR THIS SECTION WAS TAKEN AT STATION 25+90.

2. ABANDONED PIEZOMETERS INDICATED BY ASTERISK (*)

10 0 10 20
VERT SCALE

50 0 50 100
HORIZ. SCALE

SCALE IN FEET



PNEUMATIC PIEZOMETER

U S ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

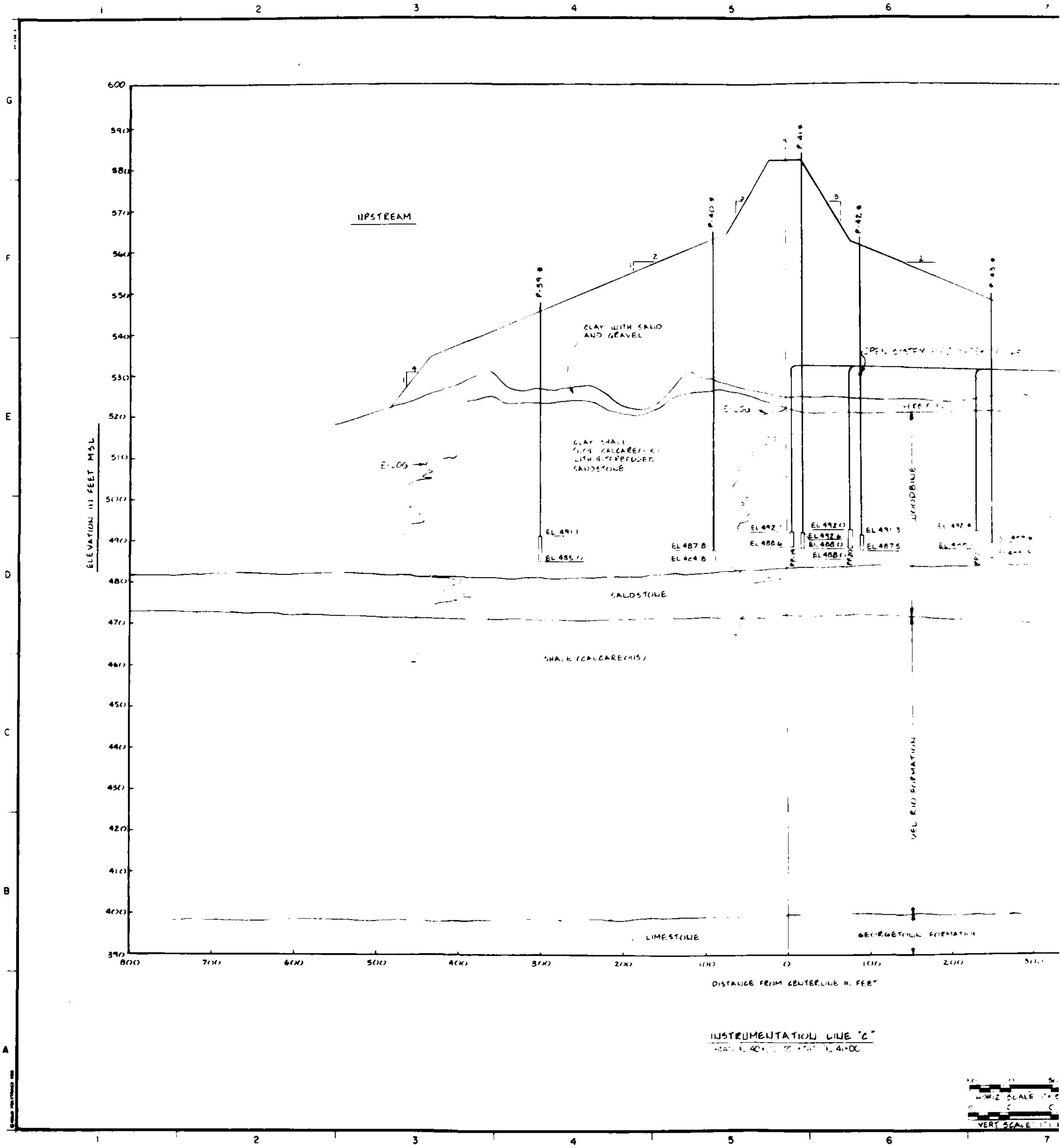
DESIGNED BY W. NICHOLS, A. BRANCH
DRAWN BY R. L. HILL
CHECKED BY L. BRUNETT, T. SCHMIDT

BRAZOS RIVER BASIN, TEXAS
AQUILLA LAKE
AQUILLA CREEK, TEXAS
INITIAL EMBANKMENT
PIEZOMETER SECTION
LINE B1

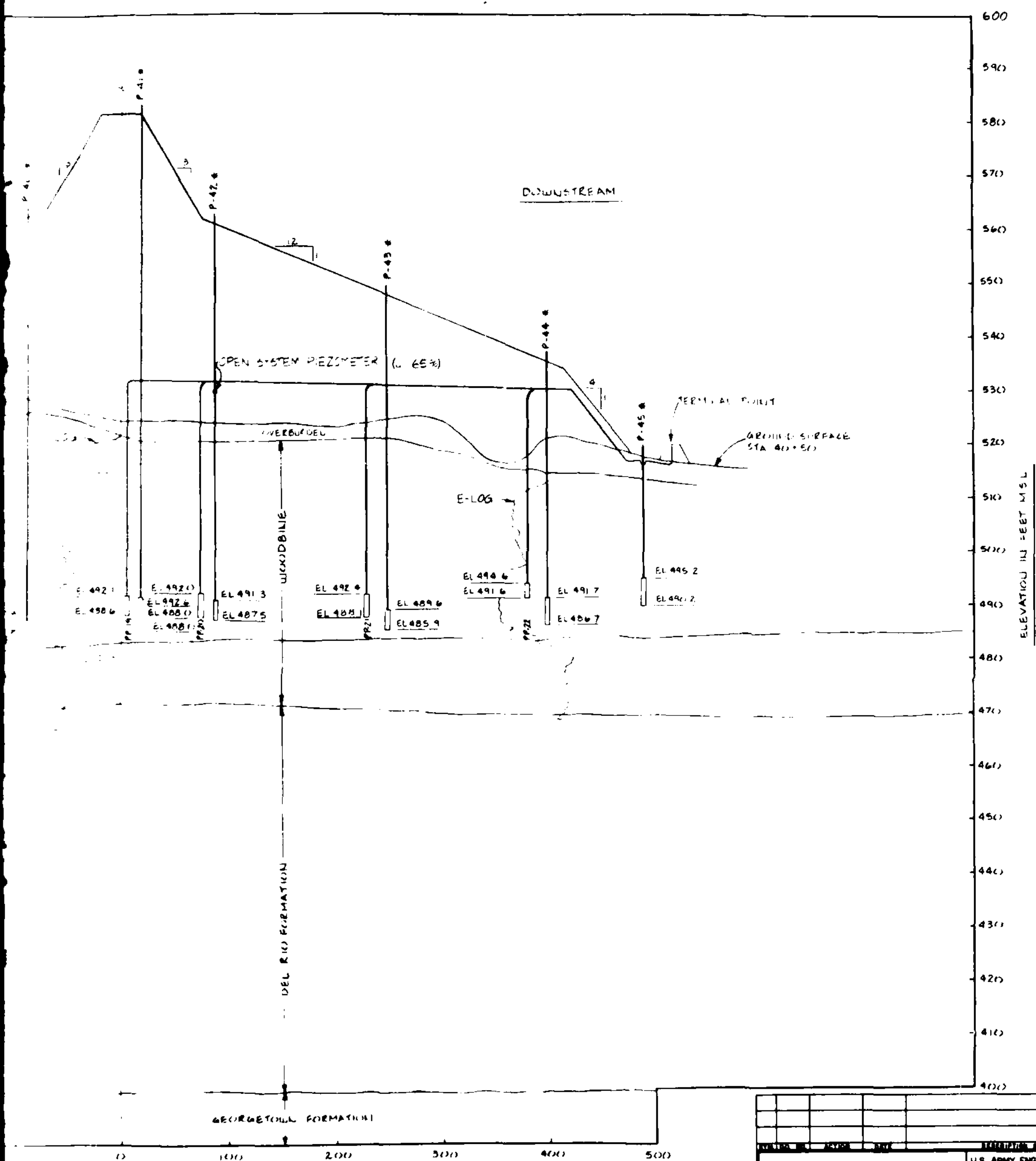
H. E. KARBS

SHEET NO 1 OF 4

PLATE 37



INSTRUMENTATION LINE "C"



INSTRUMENTATION LINE "C"

NOTES:

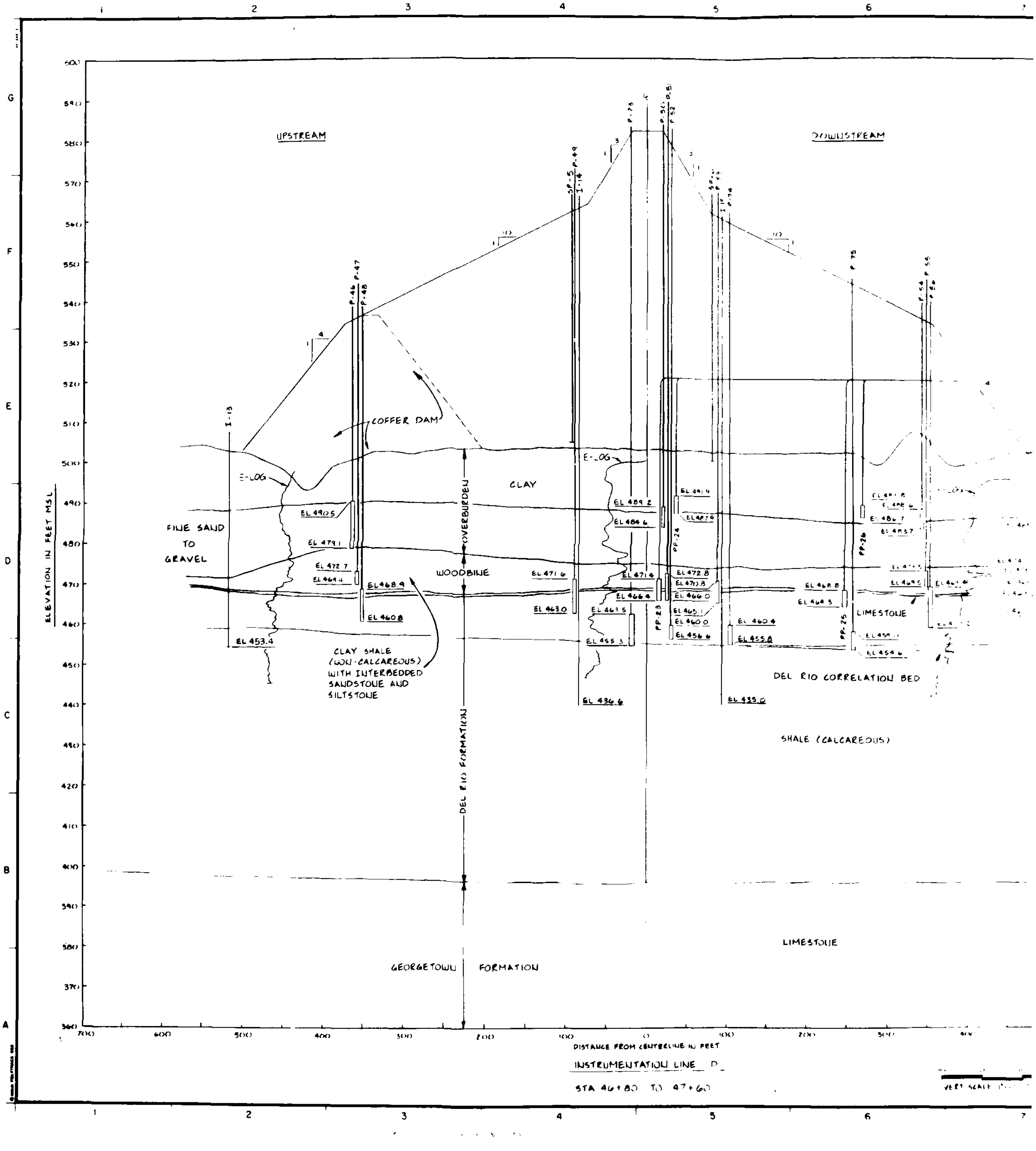
1. ABANDONED PIEZOMETERS INDICATED BY ASTERISK (*)
2. MAXIMUM PIEZOMETRIC ELEVATION RECORDED AND CORRESPONDING PERCENT PORE PRESSURE (U%)

HORIZ SCALE 1" = 50'-0"

VERT SCALE 1" = 10'-0"

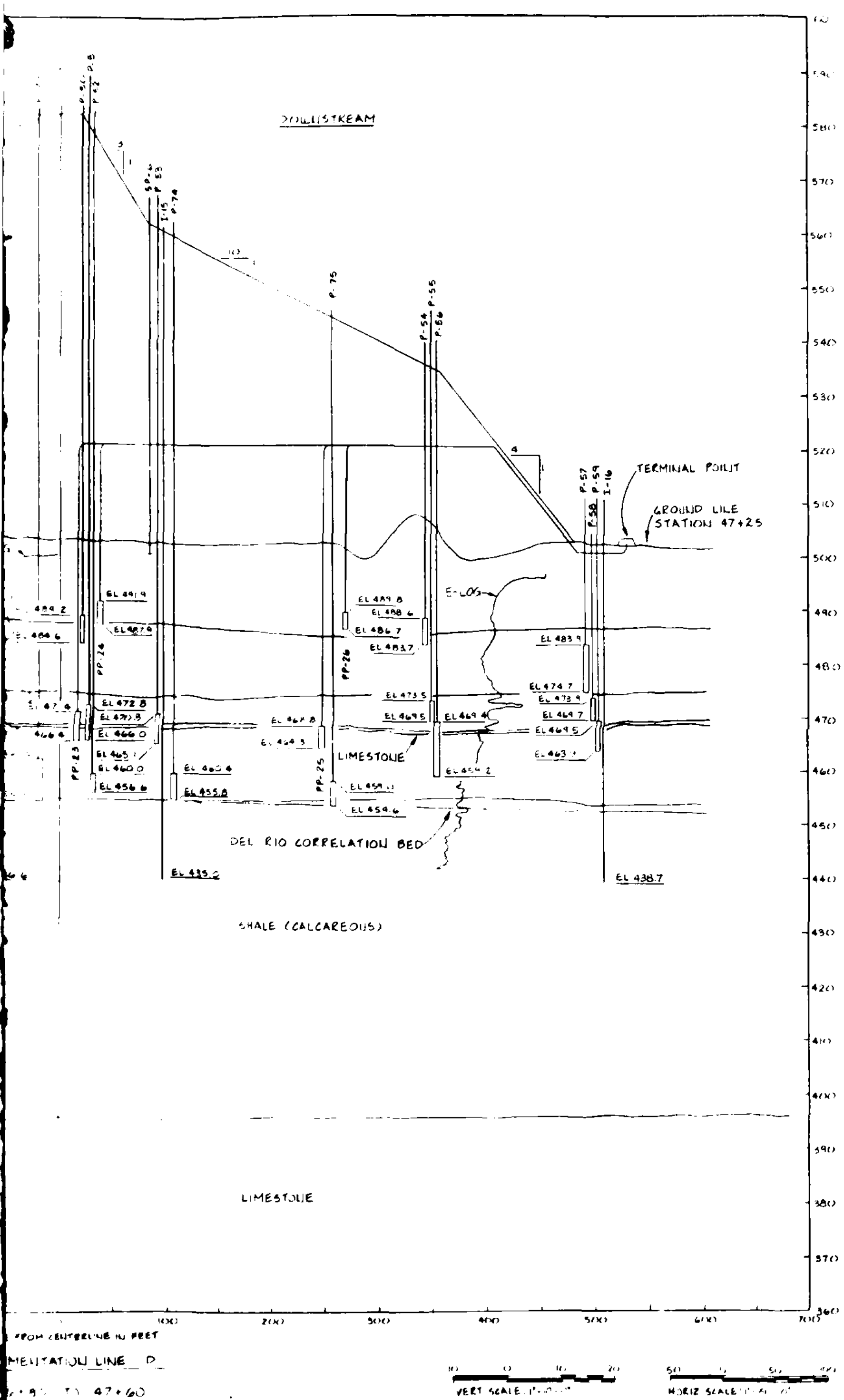
	U.S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS
DESIGNED BY	AQUILLA LAKE AQUILLA CREEK TEXAS INITIAL EMBANKMENT PIEZOMETER SECTION LINE C
DRAWN BY L. DELAMARE	
REVIEWED BY T. SCHMIDT	
SUBMITTED BY H. E. KARBS ENGINEER	INV NO. / DATED / CONTR NO / DRAWING NUMBER / SHEET NO OF

PLATE 38



INSTRUMENTATION LINE D

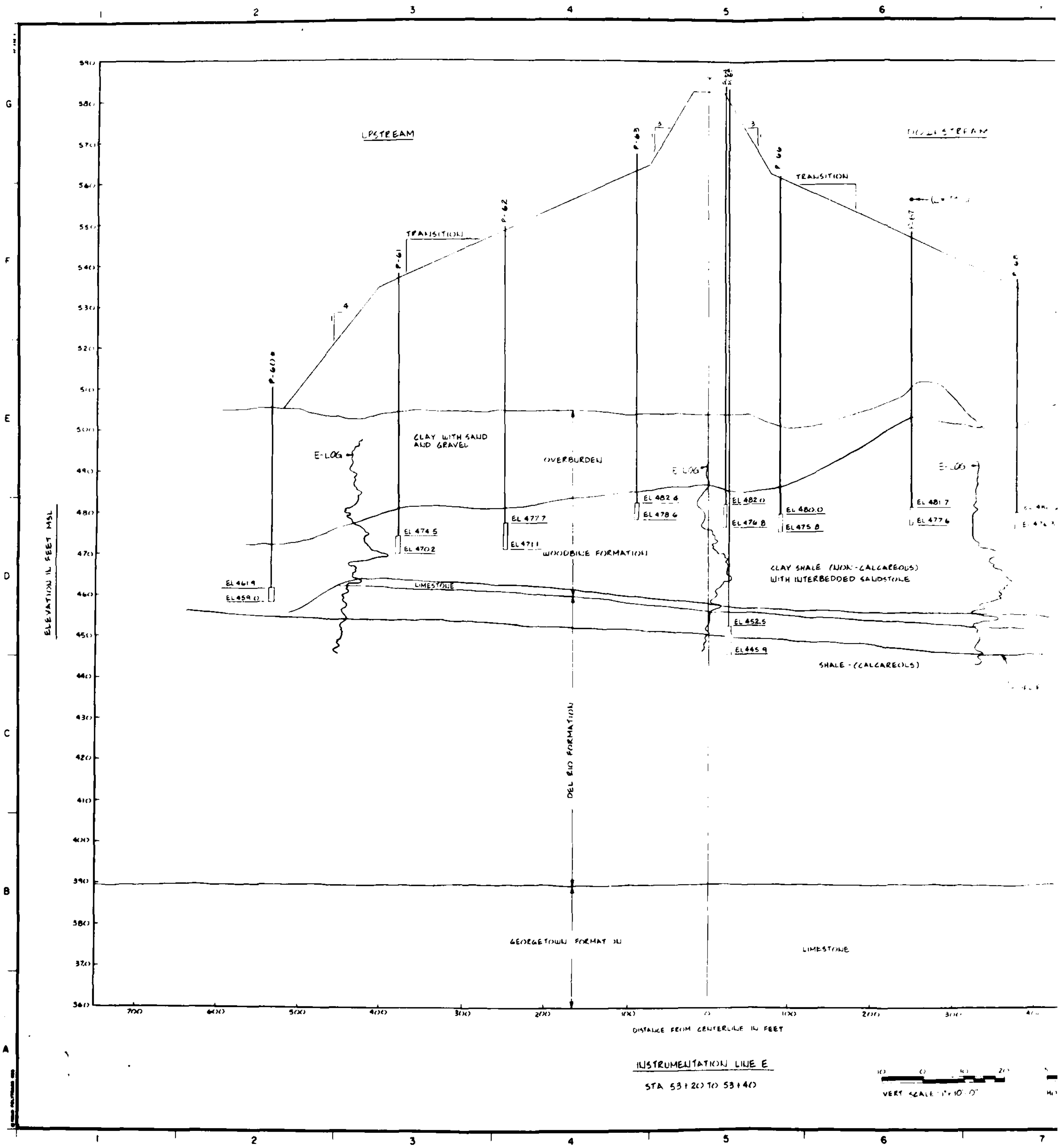
STA 46+80 TO 47+60



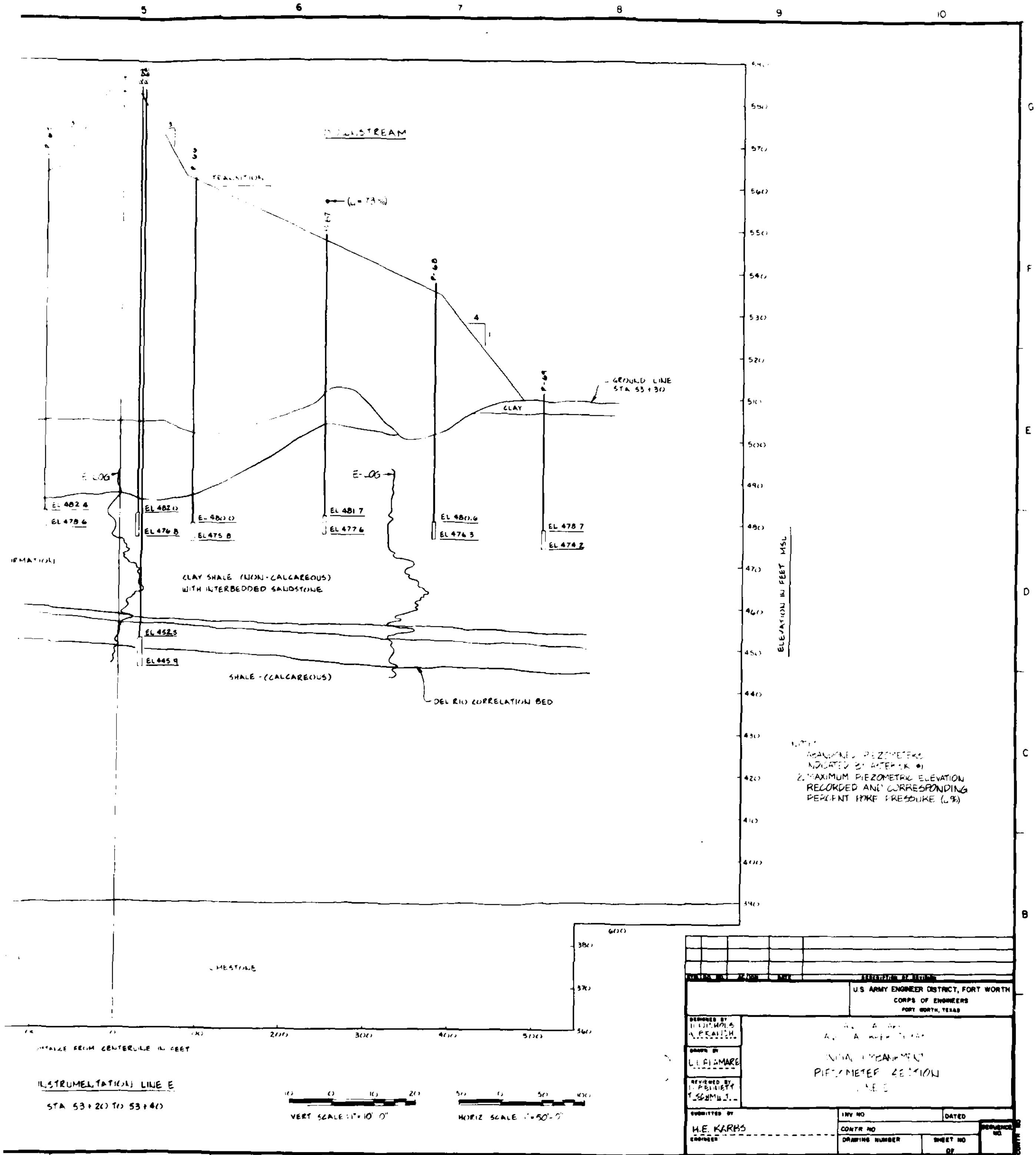
NOTE:
1. SETTLEMENT PLATES 5,6 ARE AT 47+50
INCLINOMETERS 14,15,16 ARE AT 46+80
INCLINOMETER 13,15 AT 47+50

	U.S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS
DESIGNED BY	AQUILLA LAKE INITIAL EMBANKMENT INSTRUMENTATION LINE D
DRAWN BY L. DE LAMARE	
REVIEWED BY	
SUBMITTED BY H.E. KARBS ENGINEER	INV NO / DATED CONTR NO DRAWING NUMBER / SHEET NO

PLATE 39



INSTRUMENTATION LINE E
STA 53+20 TO 53+40



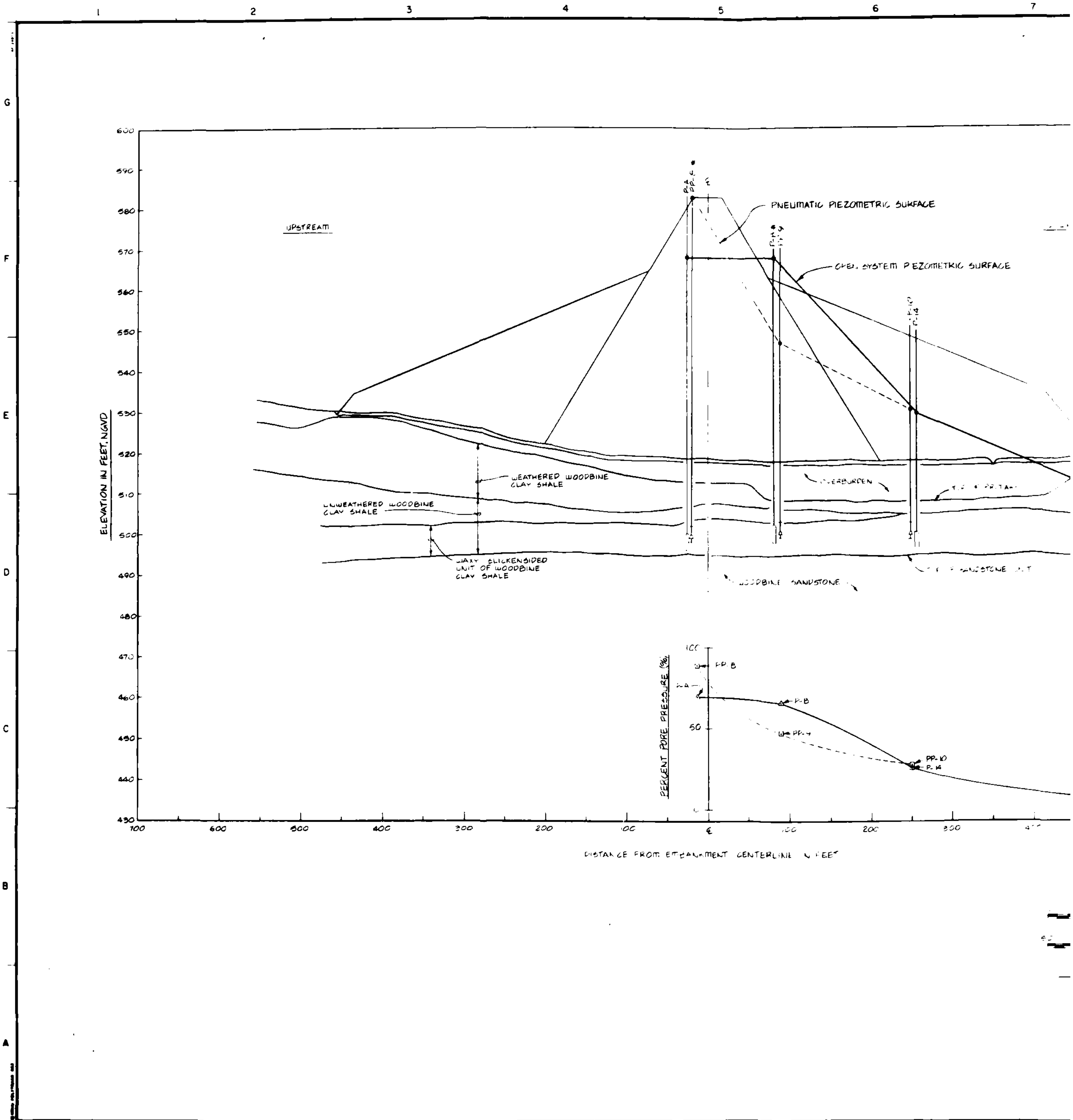
NOTES:
1. ABANDONED PIEZOMETERS INDICATED BY ASTERISK (*)
2. MAXIMUM PIEZOMETRIC ELEVATION RECORDED AND CORRESPONDING PERCENT HOKE PRESSURE (L%)

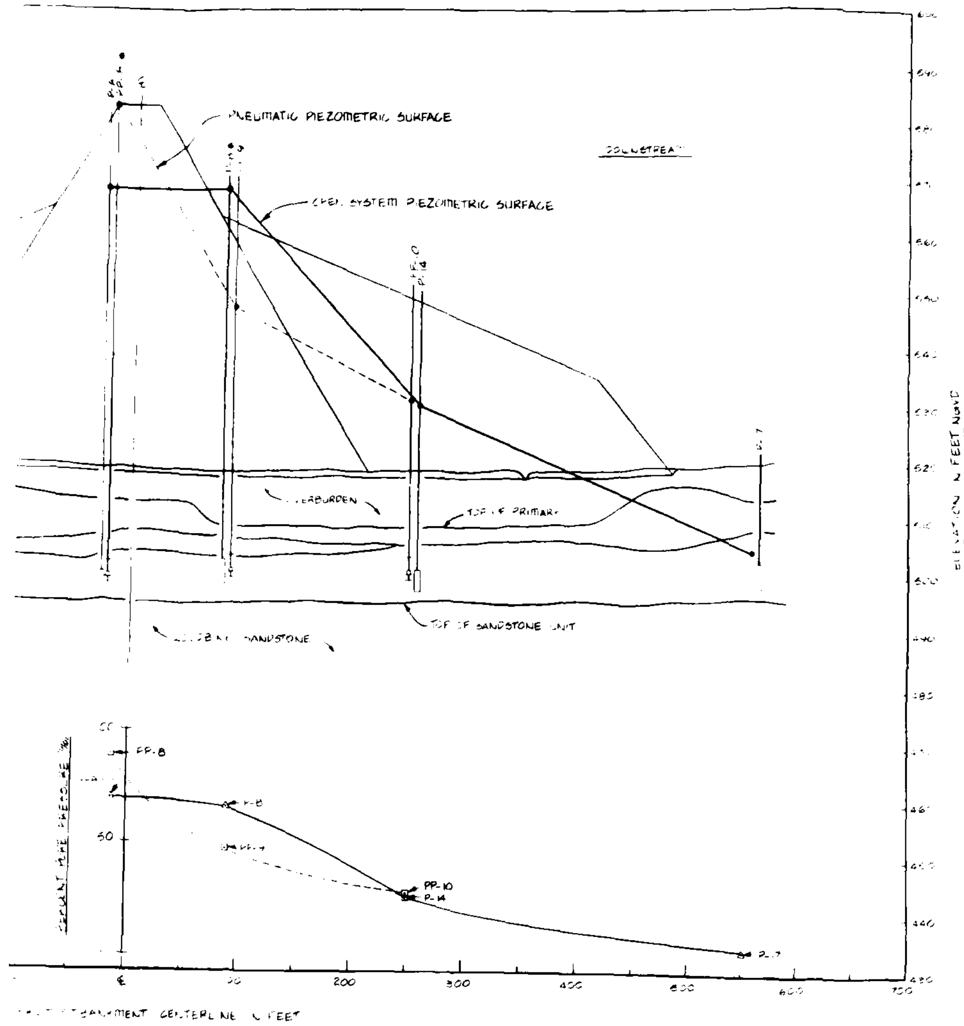
U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

PIEZOMETER SECTION

DESIGNED BY: H. NICHOLS, A. FEAUCH
DRAWN BY: L.L. FLAMARE
REVIEWED BY: L. PELLETT
SUBMITTED BY: H.E. KARBS

PLATE 40


UPSTREAM
PNEUMATIC PIEZOMETRIC SURFACE
OPEN SYSTEM PIEZOMETRIC SURFACE
WEATHERED WOODBINE CLAY SHALE
UNWEATHERED WOODBINE CLAY SHALE
WAXY SLICKENSIDED UNIT OF WOODBINE CLAY SHALE
WOODBINE SANDSTONE
OVERBURDEN
ELEVATION IN FEET, NGVD
PERCENT PORE PRESSURE (%)
PP-B
P-B
PP-4
PP-10
P-14
DISTANCE FROM EMBANKMENT CENTERLINE IN FEET
700
600
500
400
300
200
100
℄
100
200
300
600
590
580
570
560
550
540
530
520
510
500
490
480
470
460
450
440
430
50



NOTES:

1. PERCENT PORE PRESSURES PLOTTED ARE A FUNCTION OF MAXIMUM FILL HEIGHT ON [illegible] AUG 80
2. ALL PIEZOMETERS ARE MONITORING THE "[illegible]" WOODBINE

LEGEND

⊡- - - PNEUMATIC PIEZOMETERS
⊙—— OPEN SYSTEM PIEZOMETERS

VERT. SCALE

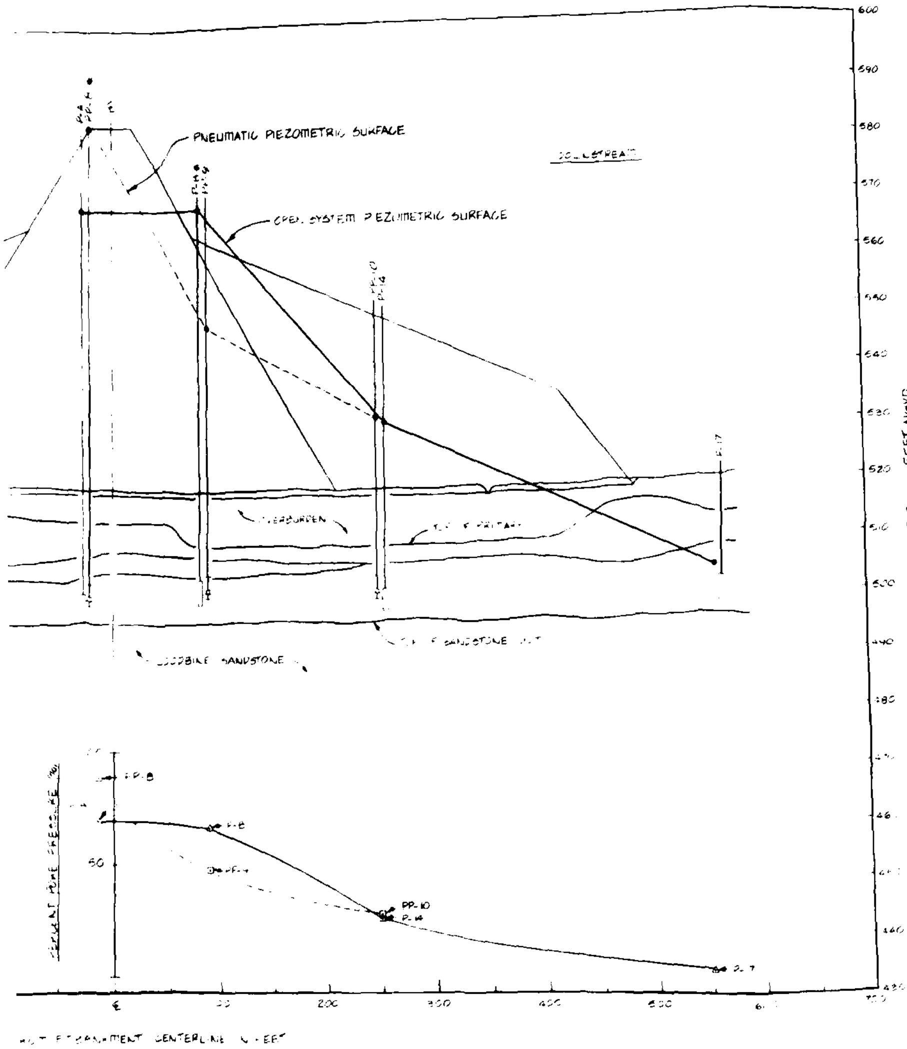
HORIZ SCALE

SCALE IN FEET

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY: L. BENNETT, R. GRISWOLD	AQUILLA LAKE AQUILLA CREEK, TEXAS INITIAL EMBANKMENT PORE PRESSURE DEVELOPMENT LINE A
DRAWN BY: K. BROOKSHIRE	
REVIEWED BY: T. SCHMIDT	
SUBMITTED BY: H. E. KARBS, ENGINEER	INV NO / DATED / CONTR NO / DRAWING NUMBER / SHEET NO OF

PLATE 41



NOTES:

PERCENT PORE PRESSURES PLOTTED ARE A FUNCTION OF MAXIMUM FILL HEIGHT ON AUG 80

2. ALL PIEZOMETERS ARE MONITORING THE WOODBINE

LEGEND

PNEUMATIC PIEZOMETERS

OPEN SYSTEM PIEZOMETERS

VERT. SCALE

HORIZ SCALE

SCALE IN FEET

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

AQUILLA LAKE
AQUILLA CREEK, TEXAS
INITIAL EMBANKMENT

PORE PRESSURE DEVELOPMENT
LINE A

DESIGNED BY L. BENNETT, R. SRISUKHO

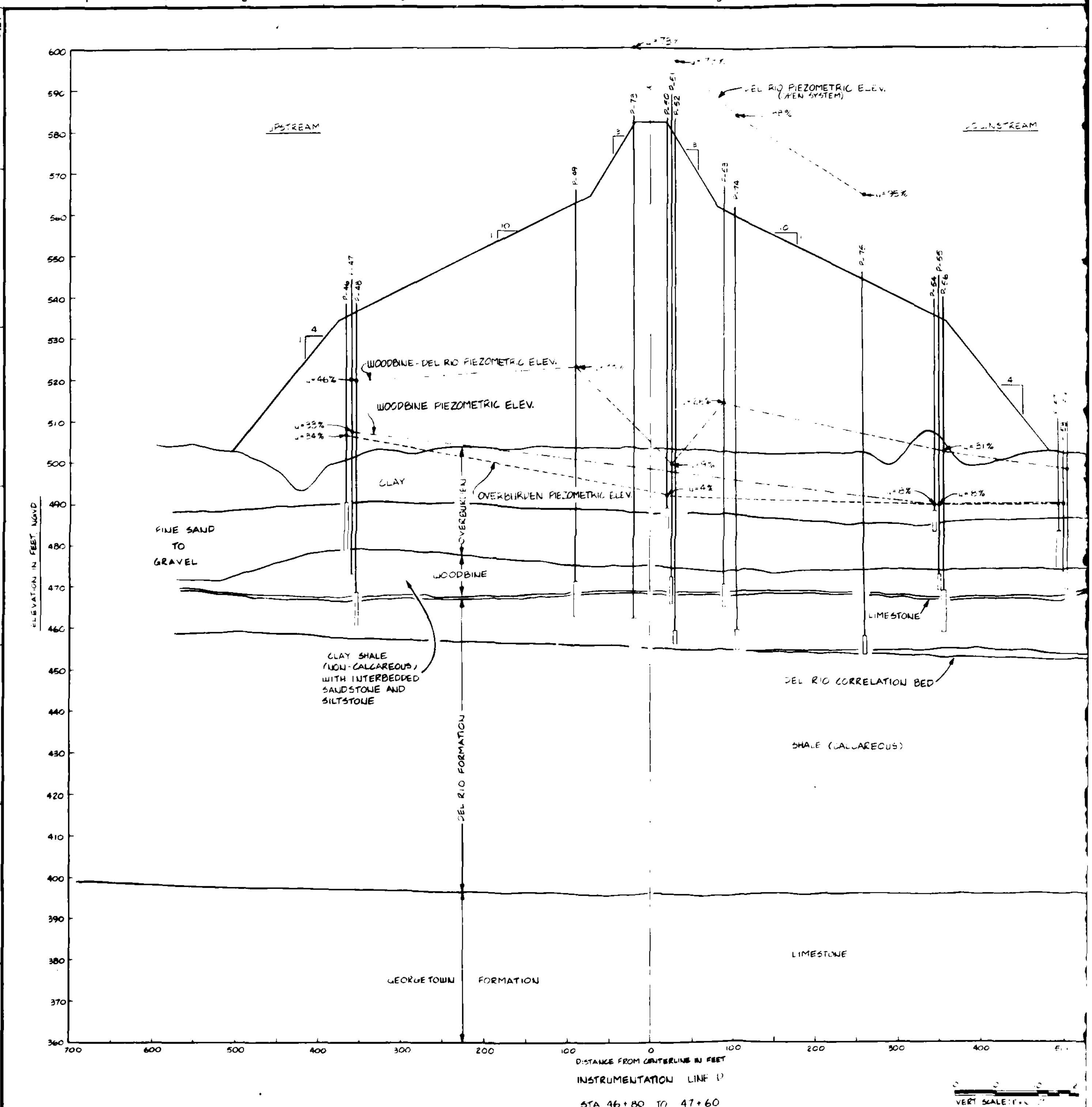
DRAWN BY K. BROMSHIRE

REVIEWED BY T. SCHMIDT

SUBMITTED BY H.E. KARBS, ENGINEER

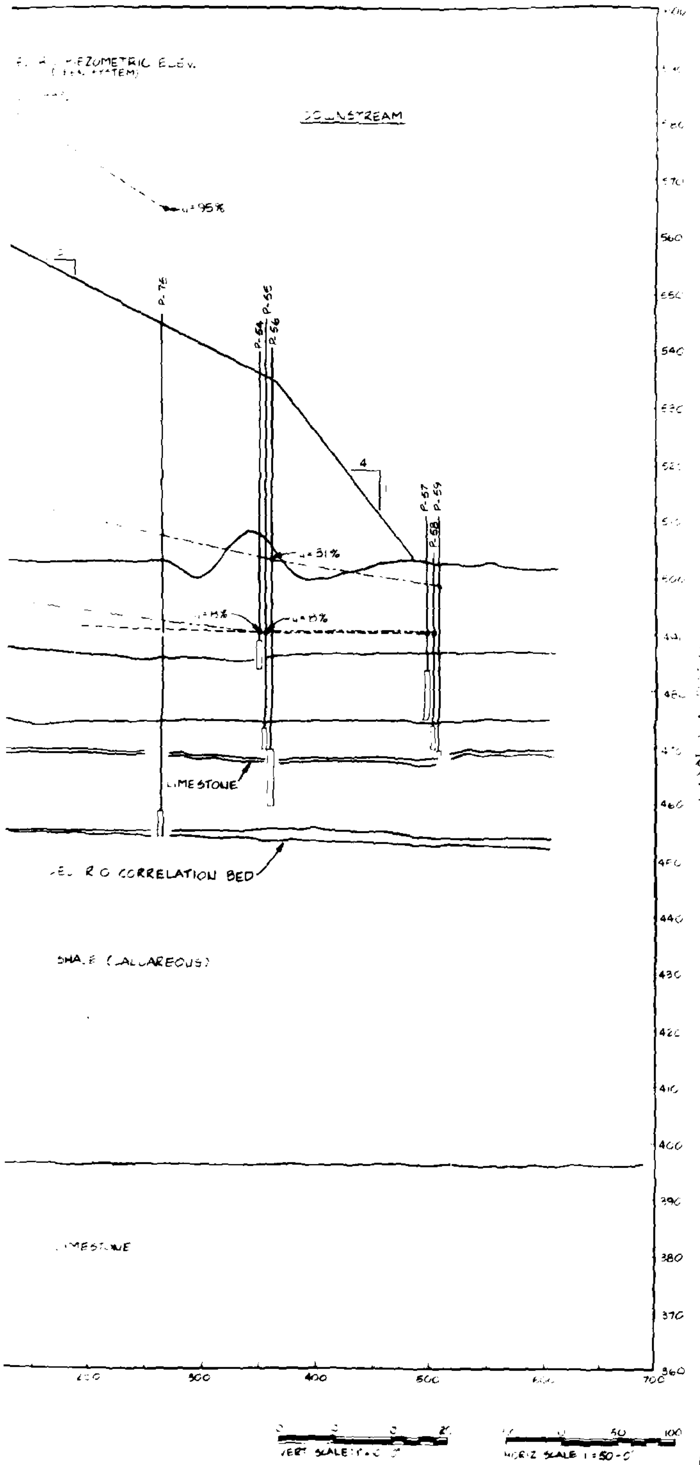
INV NO | DATED | CONTR NO | DRAWING NUMBER | SHEET NO OF | SEQUENCE NO.

PLATE 41



INSTRUMENTATION LINE D

STA 46+80 TO 47+60



NOTES:
1. PORE PRESSURES ARE A FUNCTION OF ACTUAL HEIGHT OF FILL AT PIEZOMETERS
2. MAXIMUM PIEZOMETRIC ELEVATION RECORDED AND CORRESPONDING PERCENT PORE PRESSURE (u%)

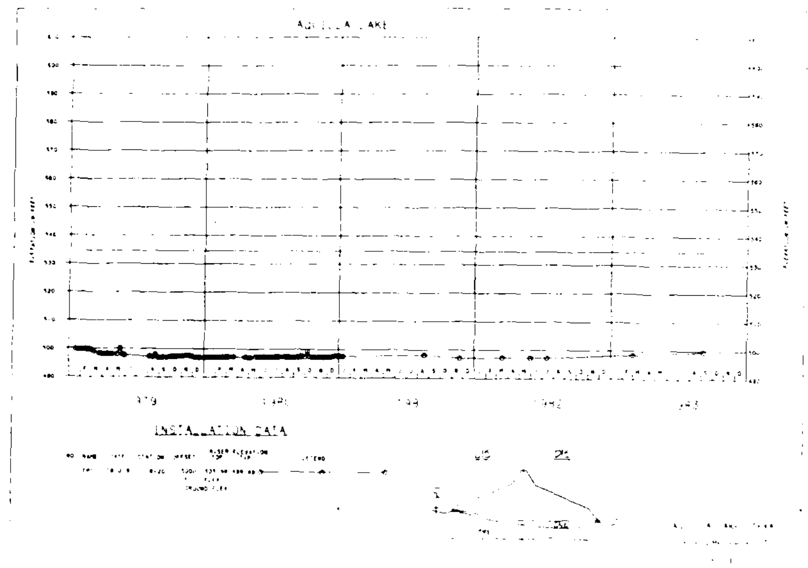
U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

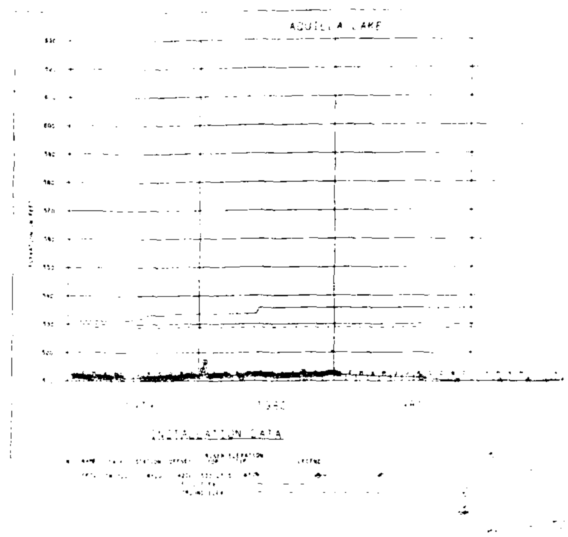
AQUILLA LAKE
AQUILLA CREEK TEXAS

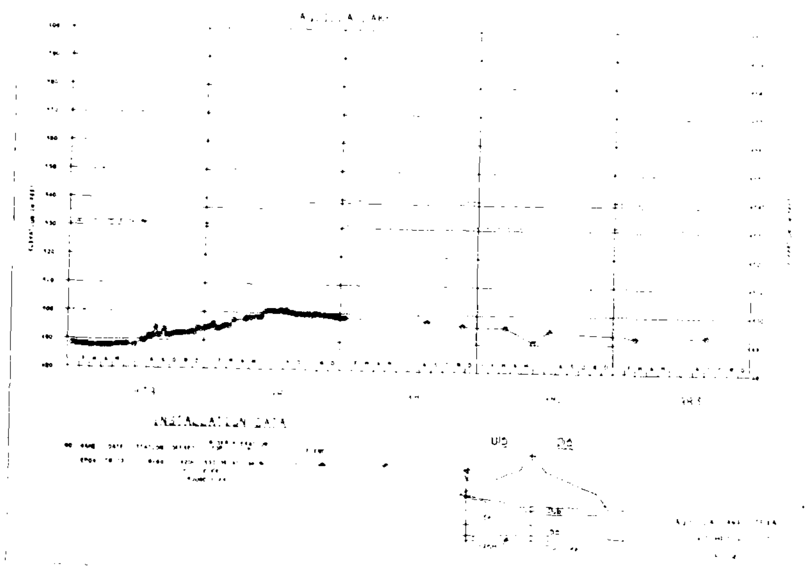
INITIAL EMBANKMENT
PORE PRESSURE DEVELOPMENT
LINE 2

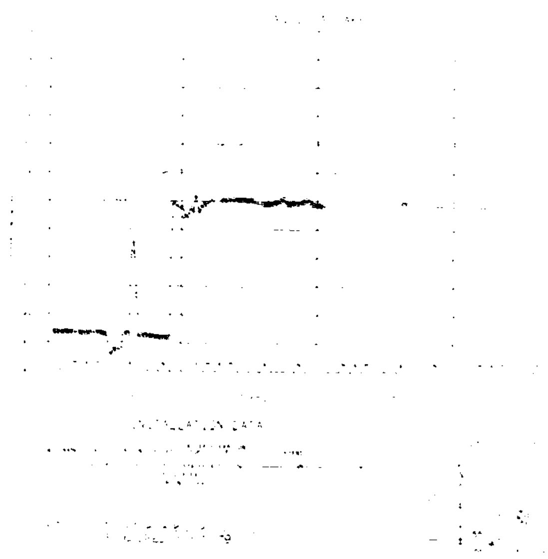
DESIGNED BY	L. BENNETT, R. GRISWOLD
DRAWN BY	K. BROOKSHIRE
REVIEWED BY	T. SCHMIDT
SUBMITTED BY	H.E. KARBS, ENGINEER
INV NO	
DATED	
CONTR NO	
DRAWING NUMBER	
SHEET NO	OF
SEQUENCE NO	

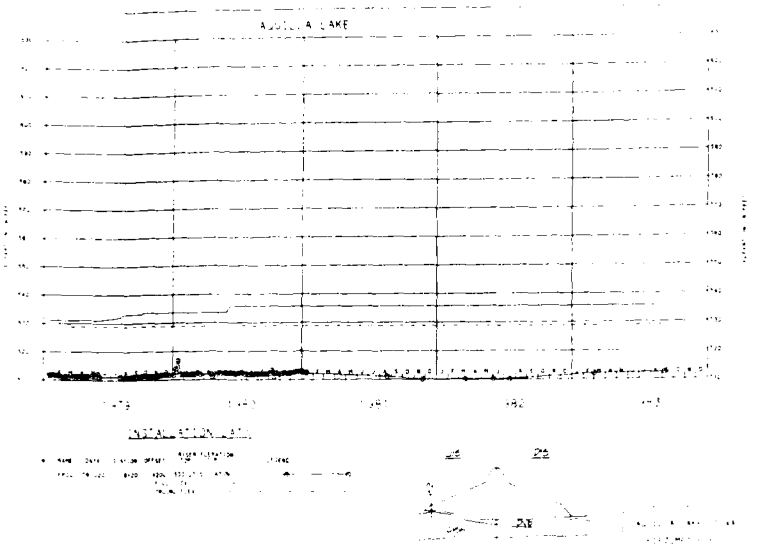
PLATE 42

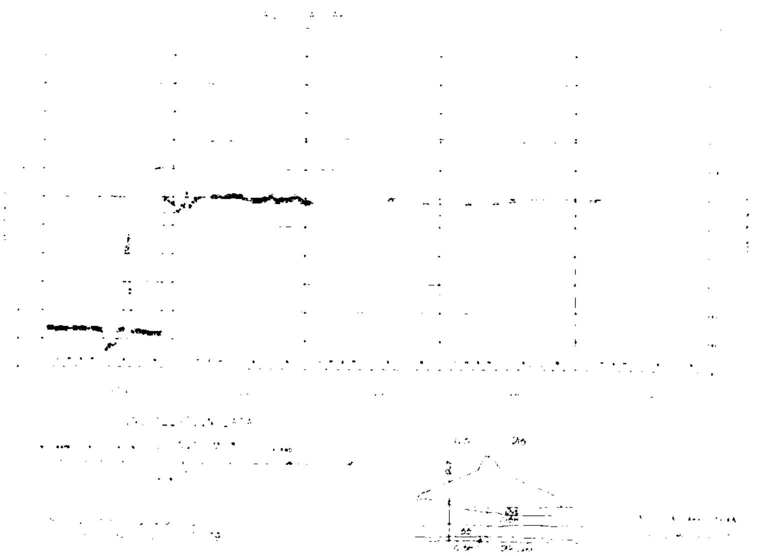

AQUILLA LAKE
INSTALLATION DATA


AQUILLA LAKE
INSTALLATION DATA


INSTALLATION DATA


INSTALLATION DATA





NOTE:

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY
N. BENNETT

DRAWN BY

SUBMITTED BY
H.E. KABBO

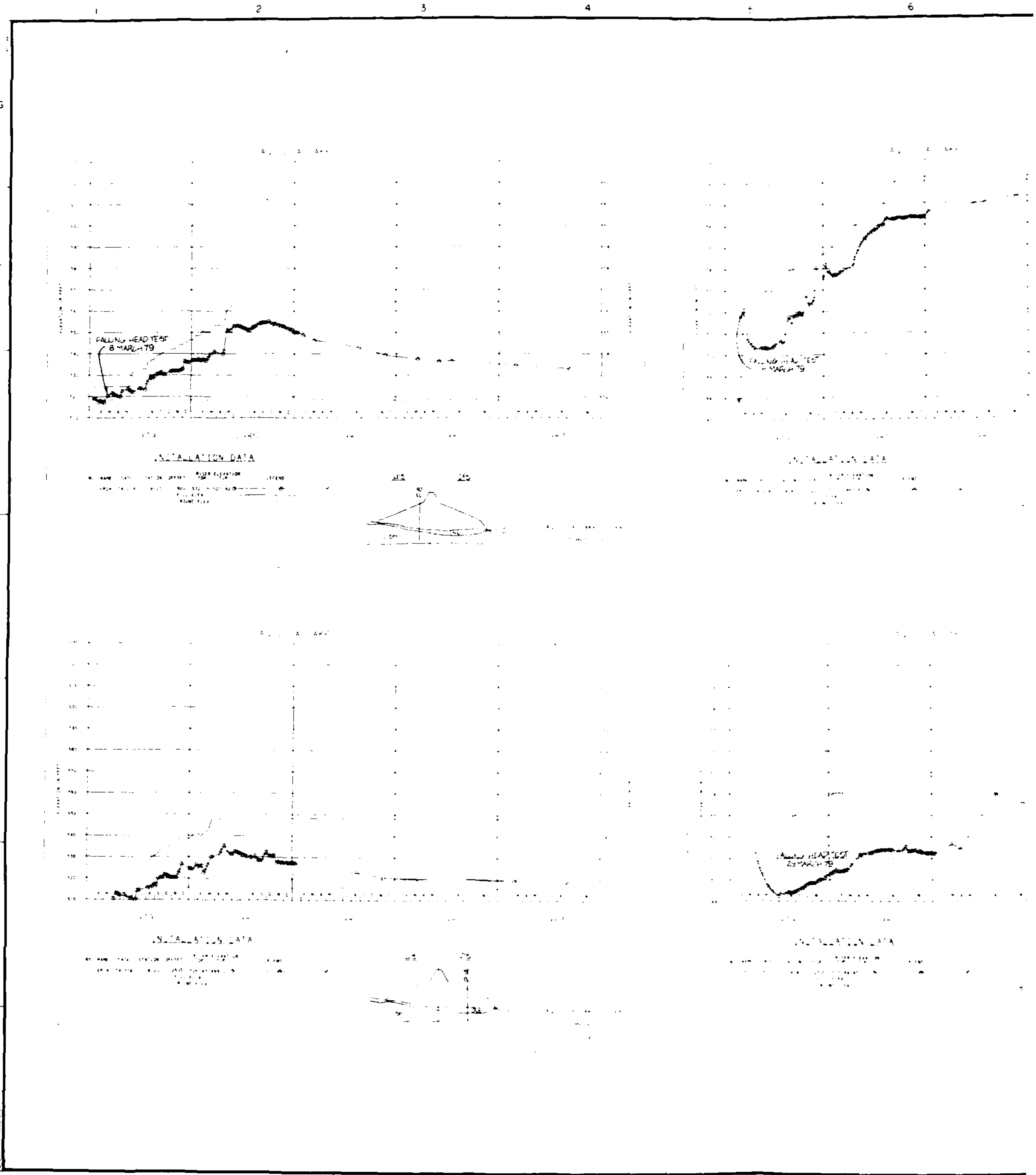
AQUILLA LAKE

PIEZOMETERS P.01, P.02, P.04, P.07

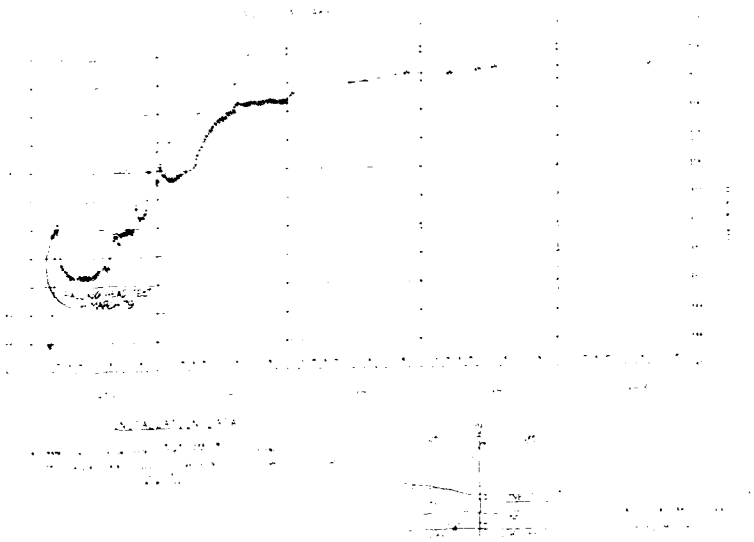
PIEZOMETER AND FILL ELEVATION VS TIME

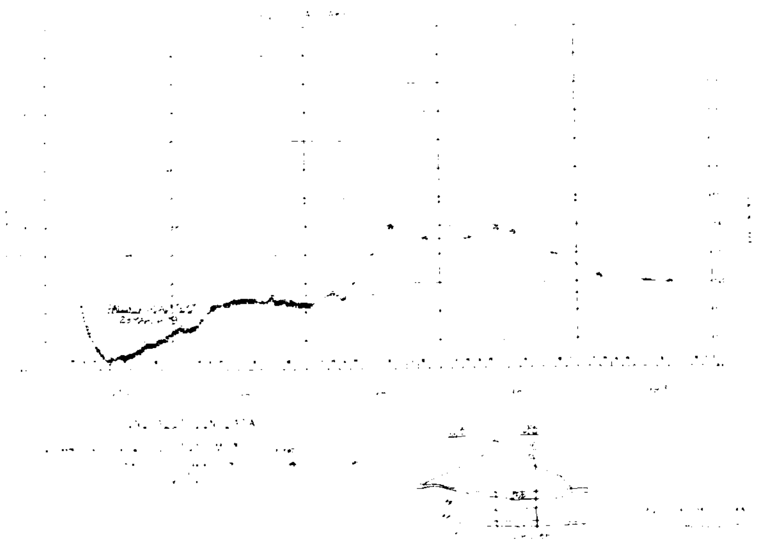
INV NO | DATED
CONTR NO
DRAWING NUMBER | SHEET NO | OF
SEQUENCE NO

PLATE 43



FALLING HEAD TEST
8 MARCH 79
INSTALLATION DATA





NOTE: RISER TOP ELEVATION IS FOR BEGINNING OF READINGS.

	U.S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS
DESIGNED BY N. BENNETT H. GARIBALDI	AQUILLA LAKE PIEZOMETERS P08, P12, P14, P15 PIEZOMETER AND FILL ELEVATION VS TIME
DRAWN BY WILTSHIRE	
REVIEWED BY T. SCHMIDT	
SUBMITTED BY H. E. KARBS ENGINEER	INV NO / DATED / CONT'R NO / DRAWING NUMBER / SHEET NO OF / SEQUENCE NO

PLATE 44

1 2 3 4 5 6

G

F

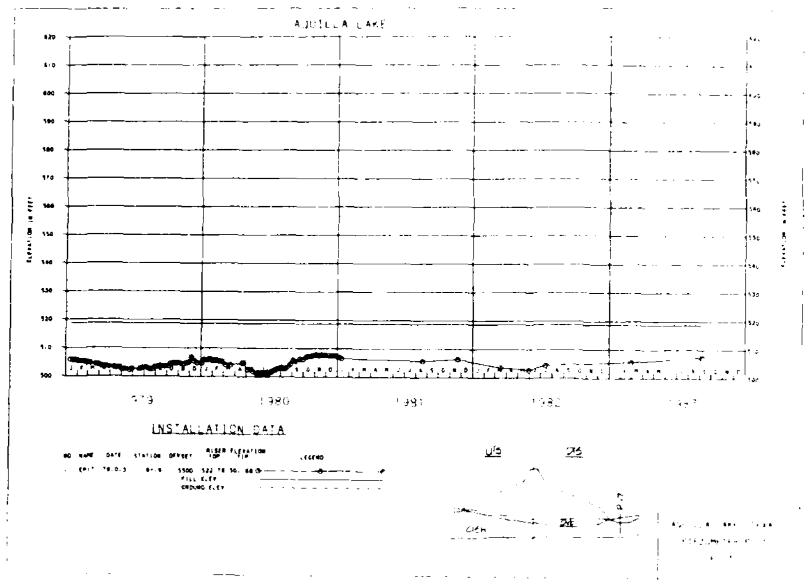
E

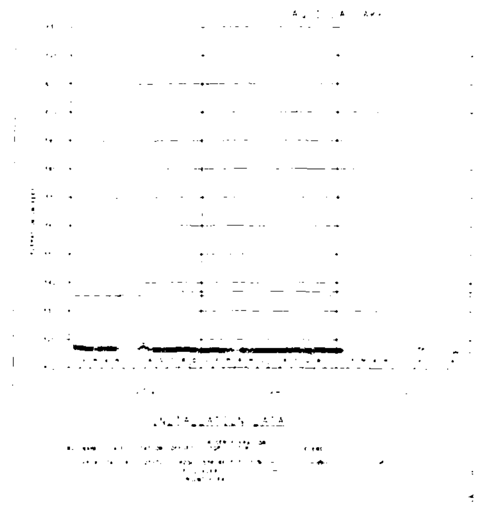
D

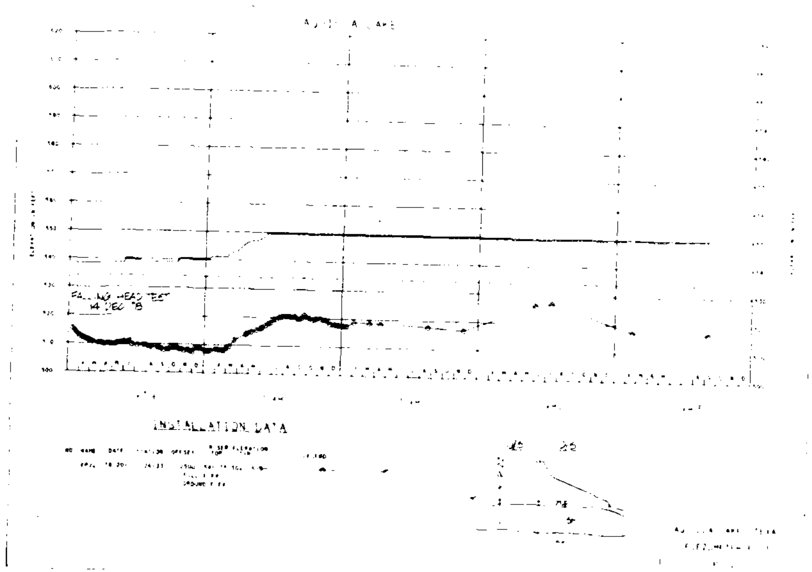
C

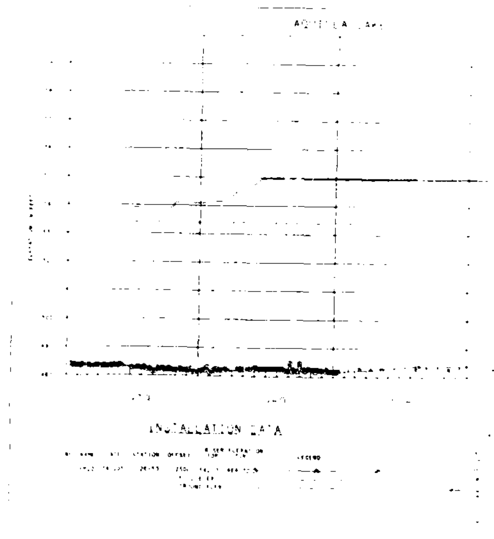
B

A

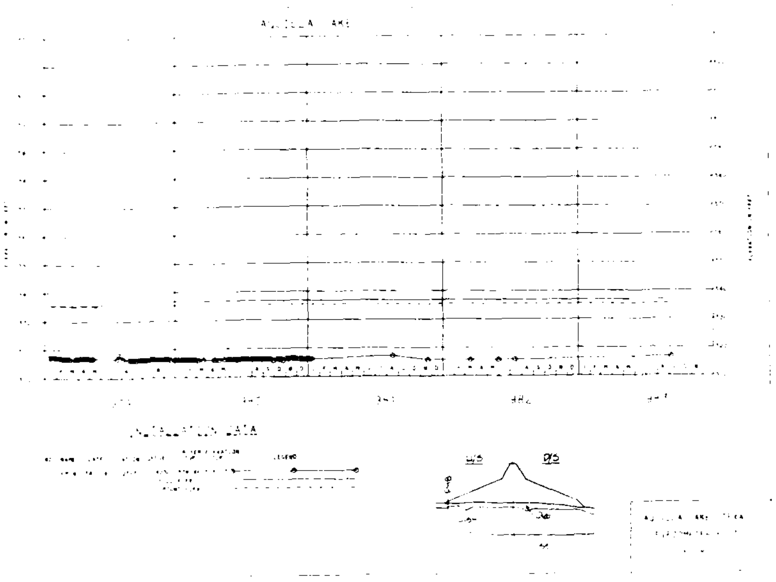


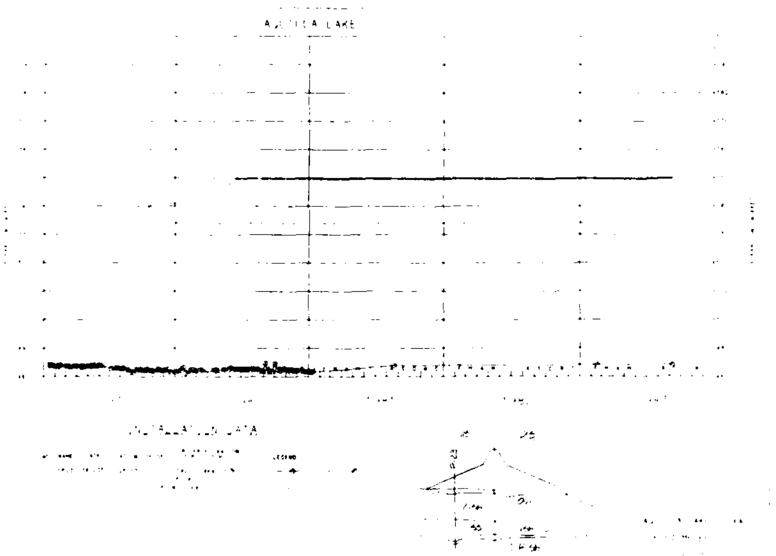






1 2 3 4 5 6





NOTE: RISER TOP ELEVATION FOR BEGINNING OF READINGS.

LEGEND

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY U. BENNETT, F. GRISWOLD

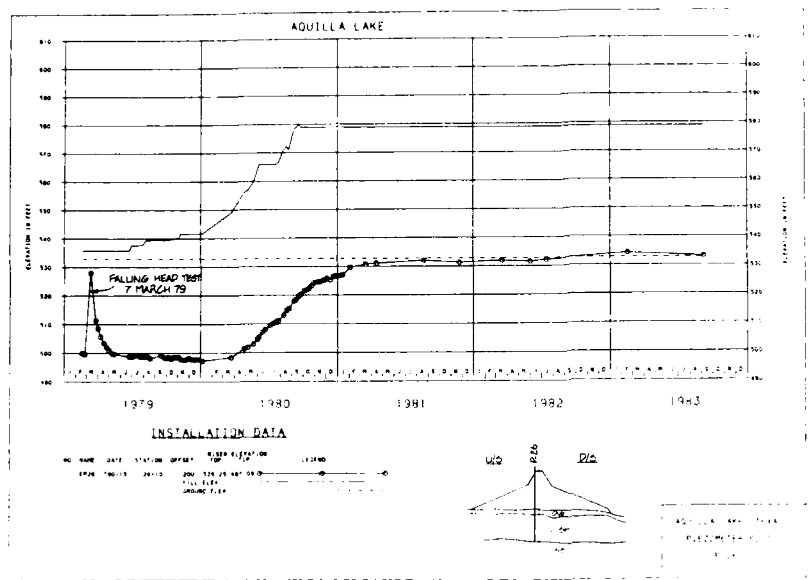
AQUILLA LAKE

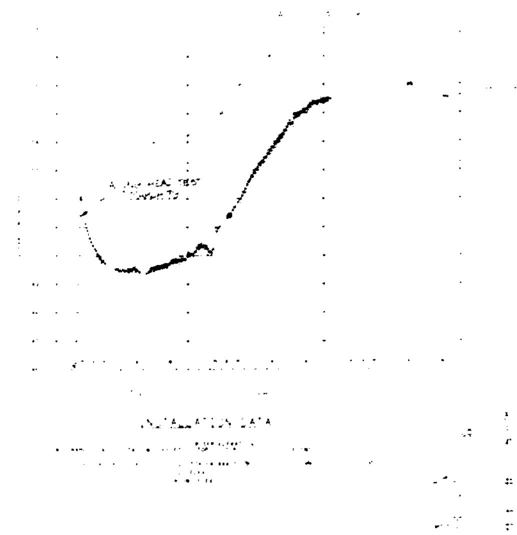
PIEZOMETERS P-17, P-18, P-22, P-23

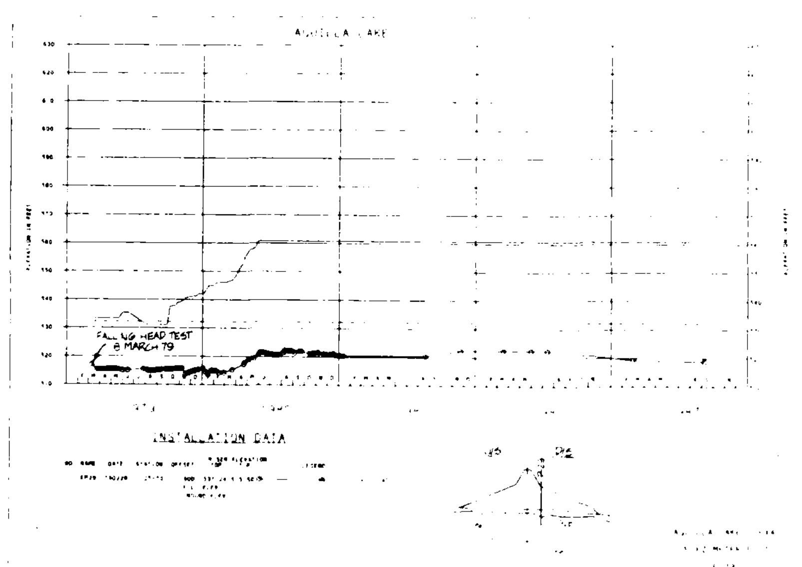
PIEZOMETER AND FILL ELEVATION VS TIME

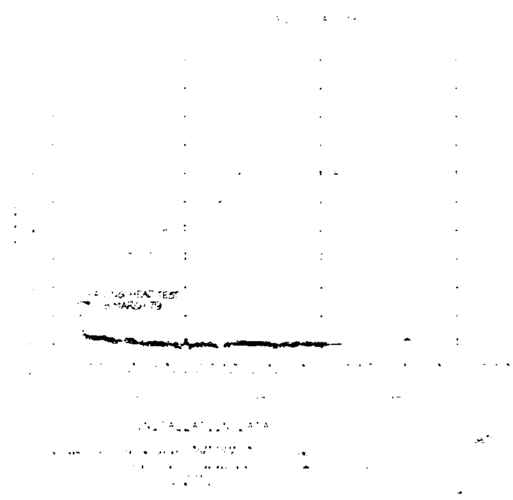
SUBMITTED BY H.E. KARBS, ENGINEER

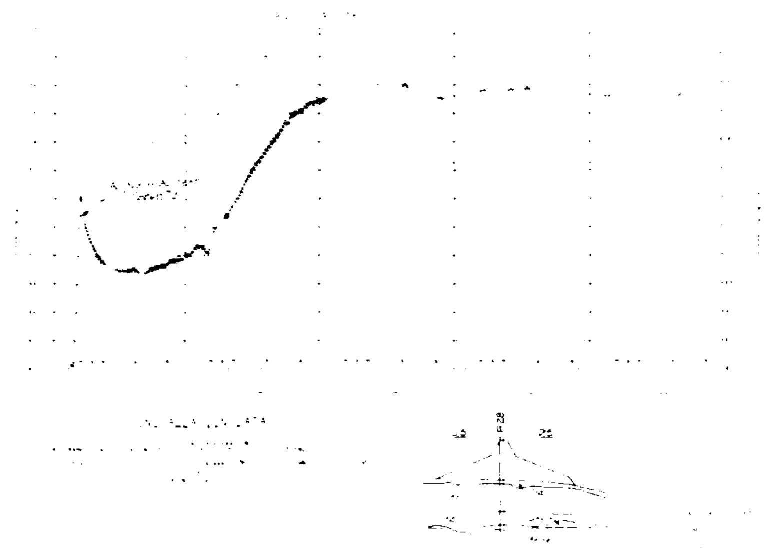
PLATE 45

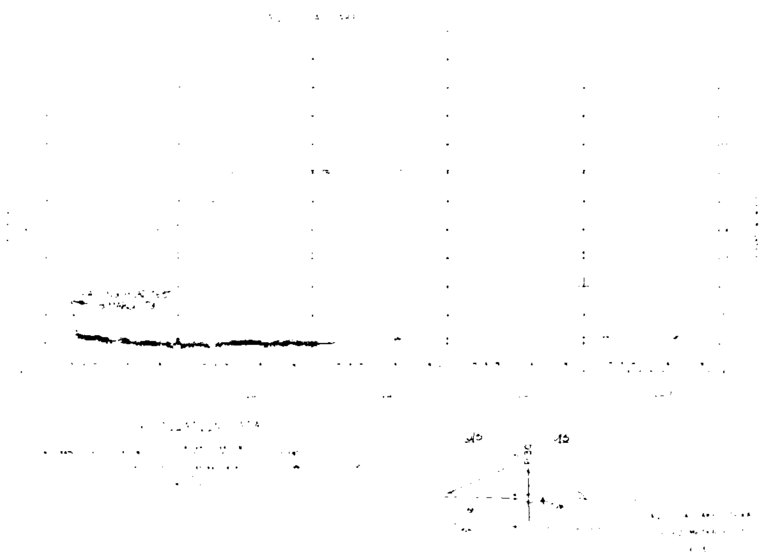

AQUILLA LAKE
FALLING HEAD TEST 7 MARCH 79
1979
1980
1981
1982
1983
INSTALLATION DATA
U/S
R26
D/S


INSTALLATION DATA


AQUILLA LAKE
FALLING HEAD TEST 8 MARCH 79
INSTALLATION DATA







NOTE: RISER TOP ELEVATION ± FOR BEGINNING OF READINGS.

LEGEND

OVB - OVERBURDEN
CSH - CLAY SHALE
Gr - GRAVEL
Sd - SAND
SS - SANDSTONE
CL - CLAY
LS - LIMESTONE
DR - DEL RIO

SYMBOL NO.	ACTION	DATE	DESCRIPTION OF REVISION

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY: N. BENNETT, K. GRISWOLD
DRAWN BY: K. BROOKSHIRE
REVIEWED BY: T. SCHMIDT

AQUILLA LAKE

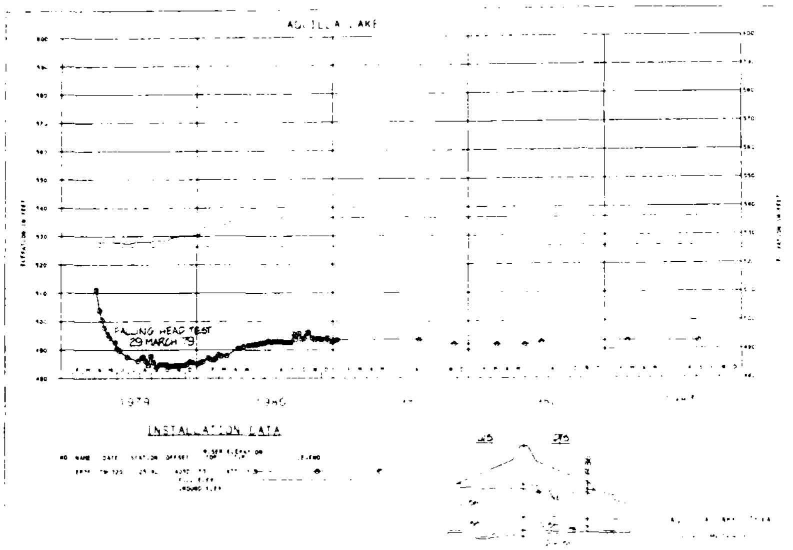
PIEZOMETERS P-26, P-28, P-29, P-30

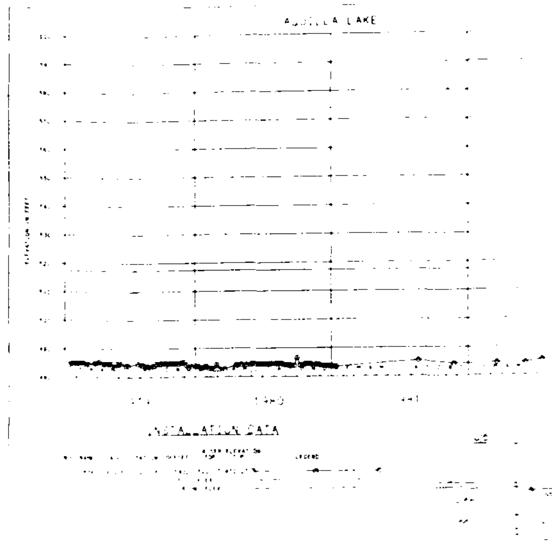
PIEZOMETER AND FILL ELEVATION VS TIME

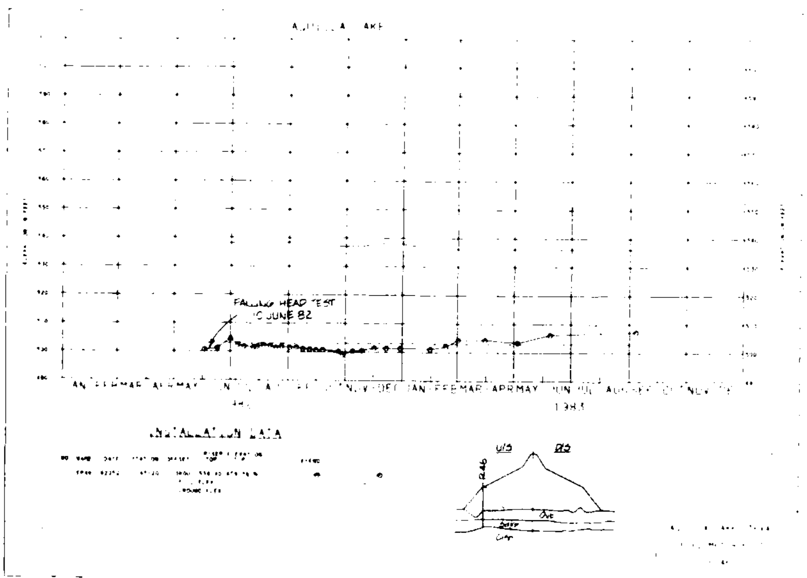
SUBMITTED BY: H.E. KARBS, ENGINEER

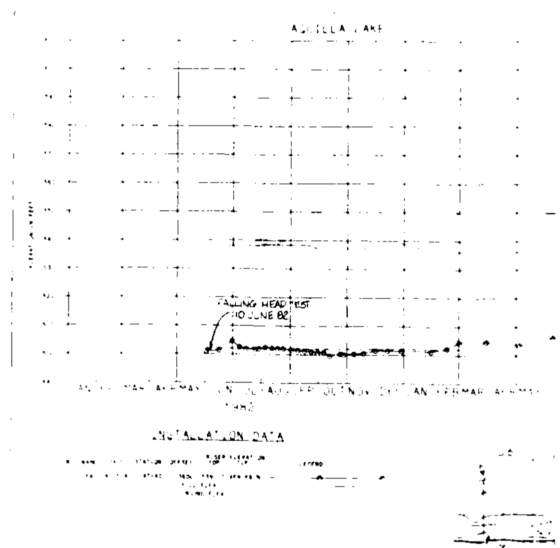
INV NO | DATED
CONTR NO | SEQUENCE NO
DRAWING NUMBER | SHEET NO OF

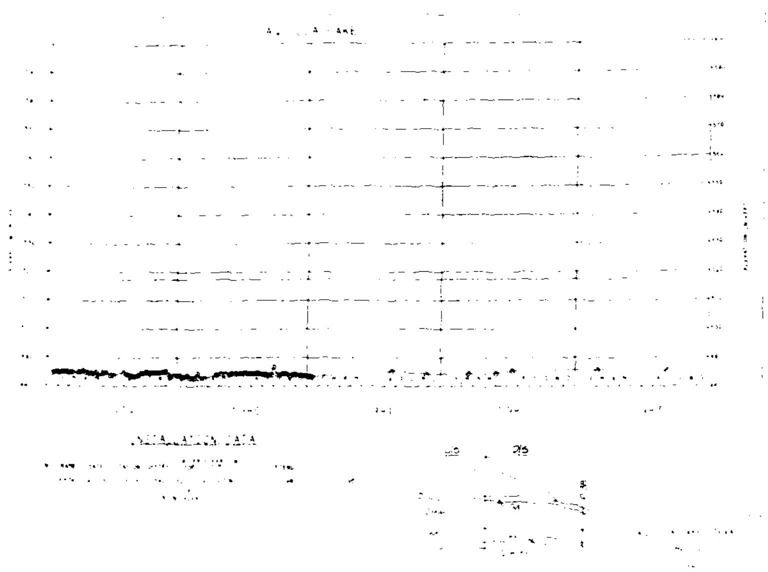
PLATE 46

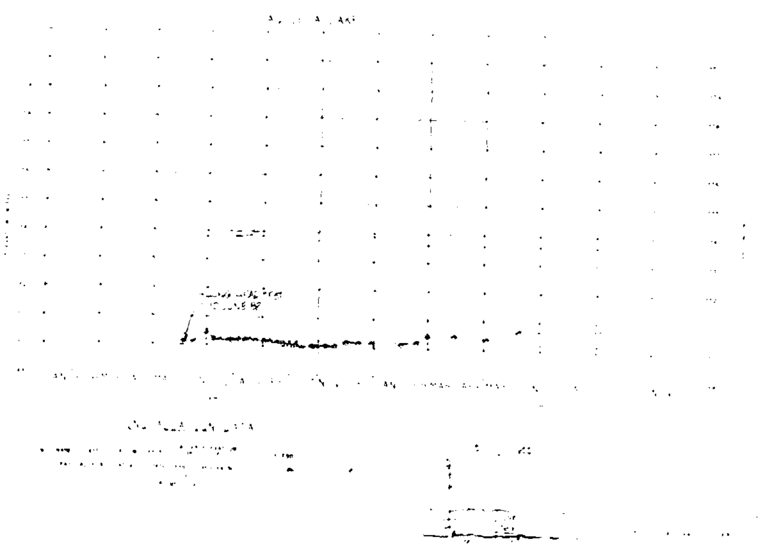

AQUILLA LAKE
FALLING HEAD TEST
29 MARCH 79
1979
1980
INSTALLATION DATA
U/S
D/S


AQUILLA LAKE
1980
INSTALLATION DATA


AQUILLA LAKE
FALLING HEAD TEST
10 JUNE 82
1983
INSTALLATION DATA
U/S
D/S


AQUILLA LAKE
FALLING HEAD TEST
10 JUNE 82
1982
INSTALLATION DATA





U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

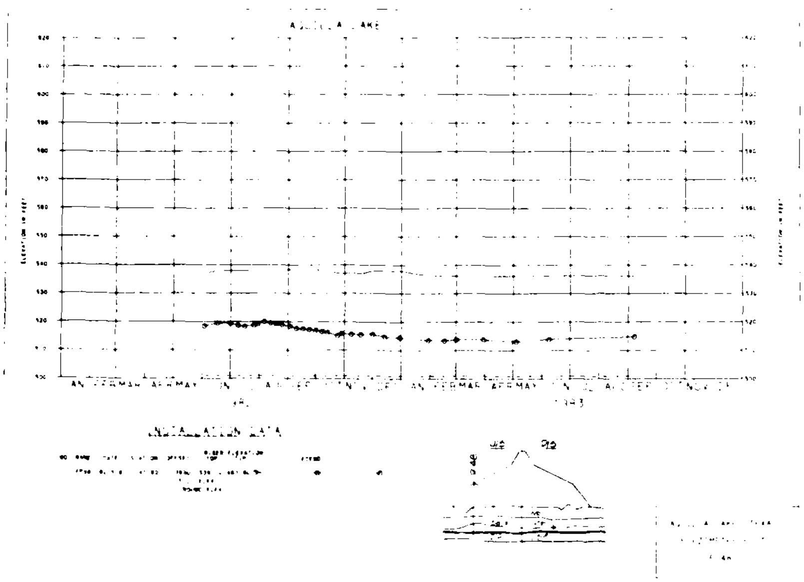
AQUILLA LAKE

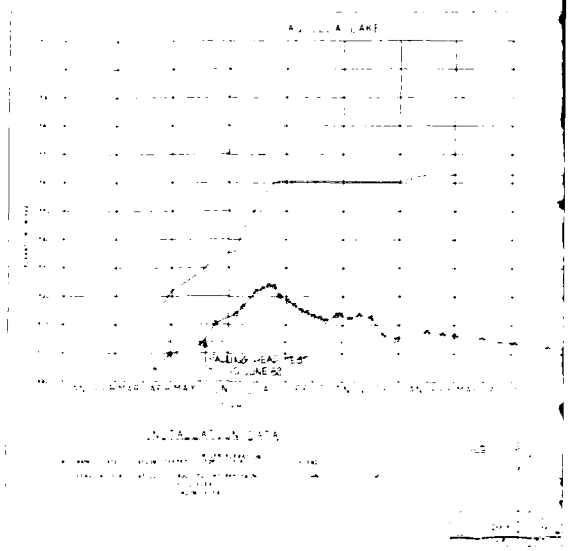
PIEZOMETERS

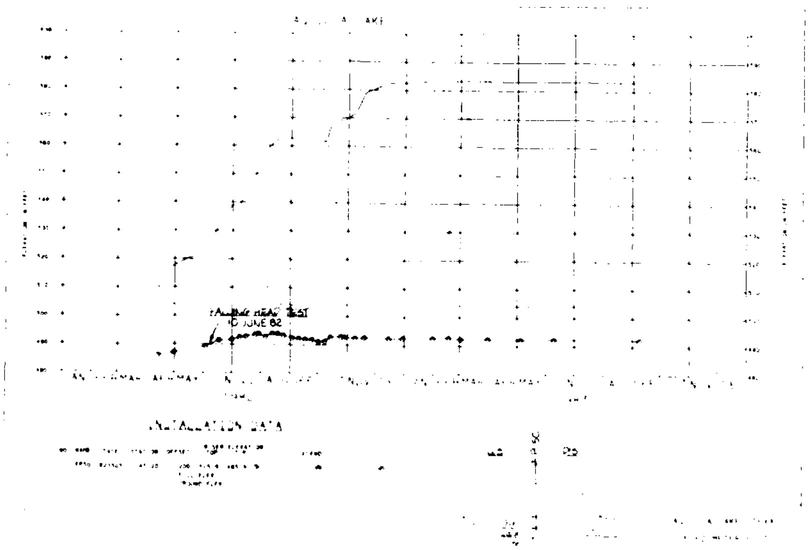
PIEZOMETER AND FILL ELEVATION VS TIME

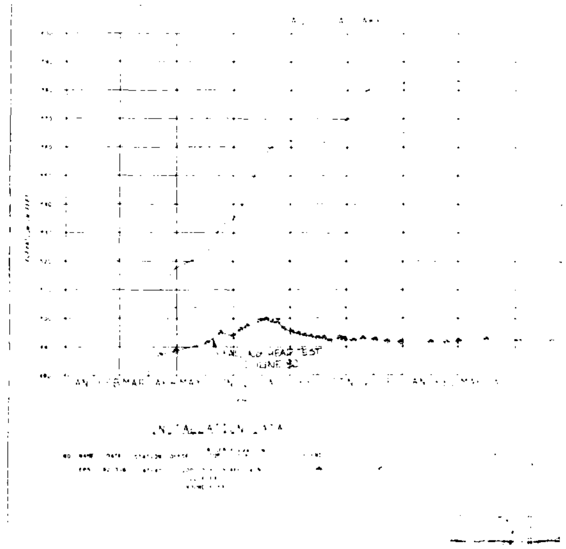
DESIGNED BY	BENNETT
DRAWN BY	
CHECKED BY	T. SCHMIDT
SUBMITTED BY	H. E. KARBS, ENGINEER
DATED	
CONTR. NO.	
DRAWING NUMBER	
SHEET NO.	OF
SEQUENCE NO.	

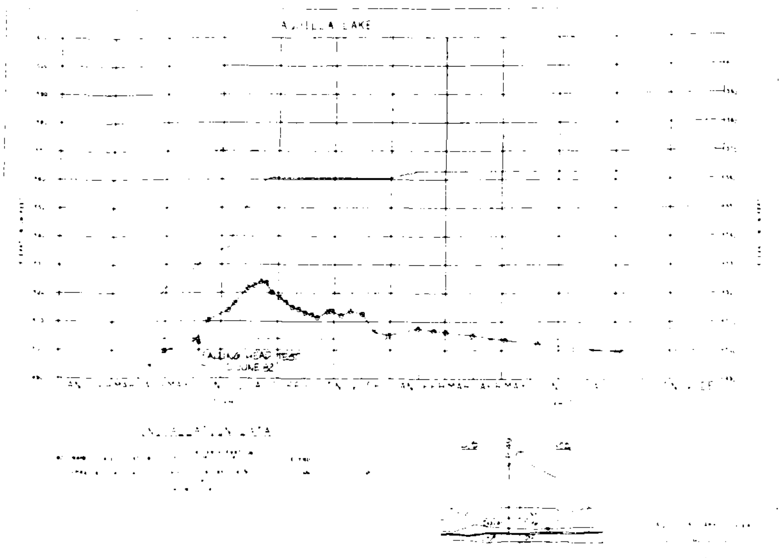
PLATE 47

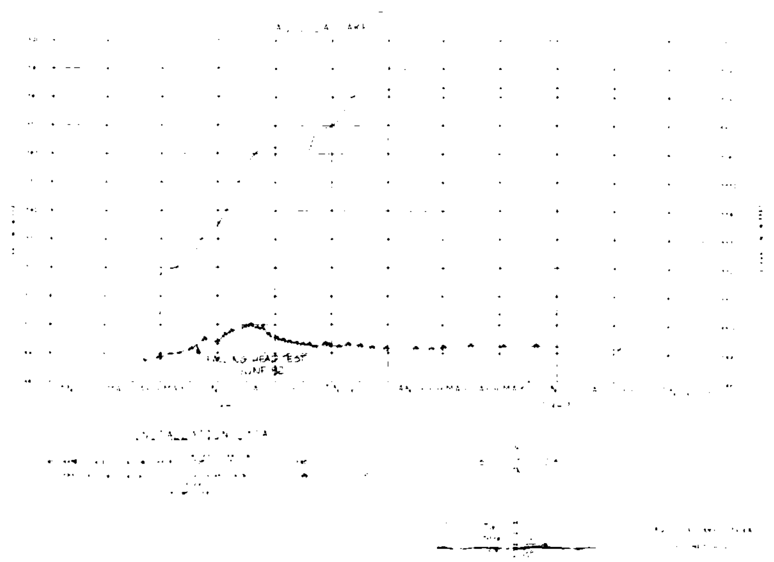

INSTALLATION DATA


FALLING HEAD TEST
10 JUNE 82
INSTALLATION DATA


FALLING HEAD TEST
10 JUNE 82
INSTALLATION DATA


FALLING HEAD TEST
10 JUNE 82
INSTALLATION DATA

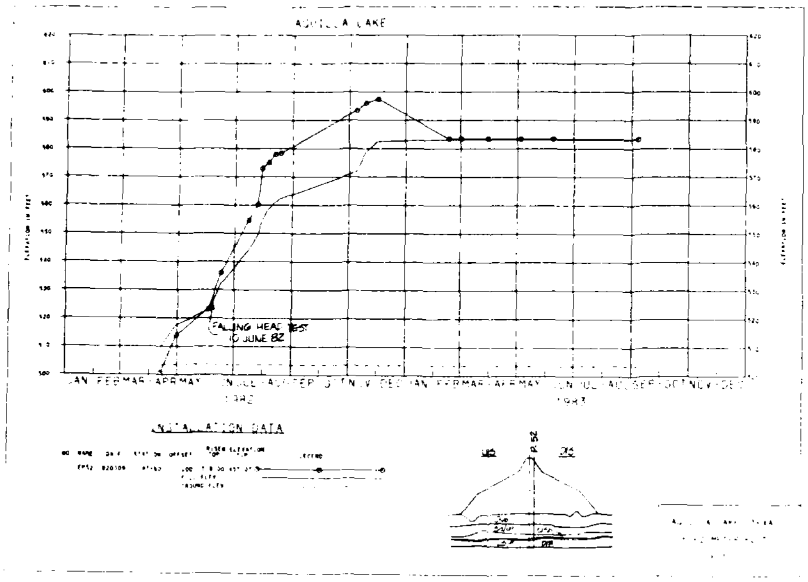


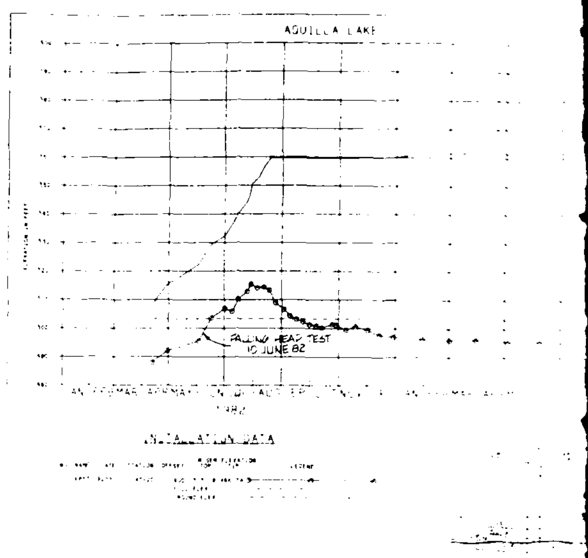


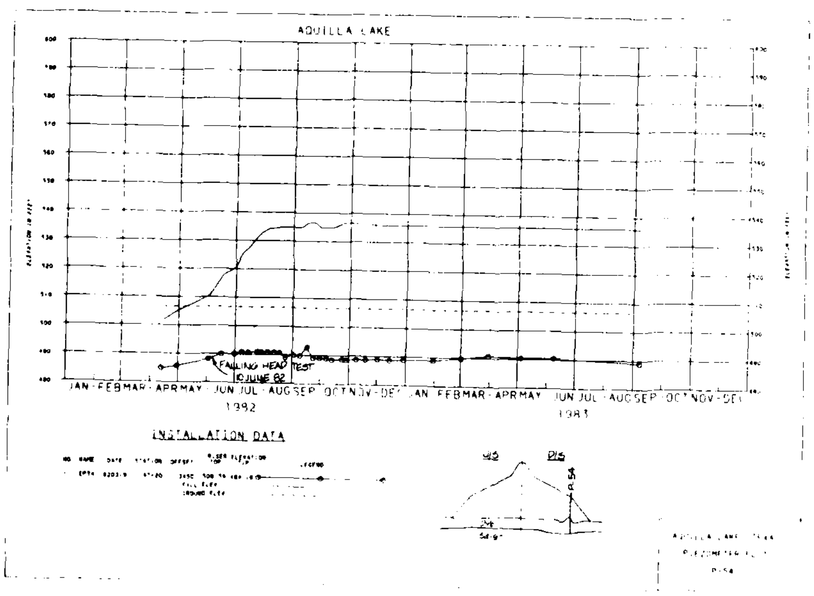
	U.S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS
DESIGNED BY N. BENNETT P. ARNOLD	AQUILLA LAKE PIEZOMETERS P48, P 49, P50, P51 PIEZOMETER AND FILL ELEVATION VS TIME
DRAWN BY K. BRUNKSHIRE	
CHECKED BY T. SCHMIDT	
SUBMITTED BY H.E. KARBS ENGINEER	INV NO / DATED CONTR NO DRAWING NUMBER / SHEET NO OF

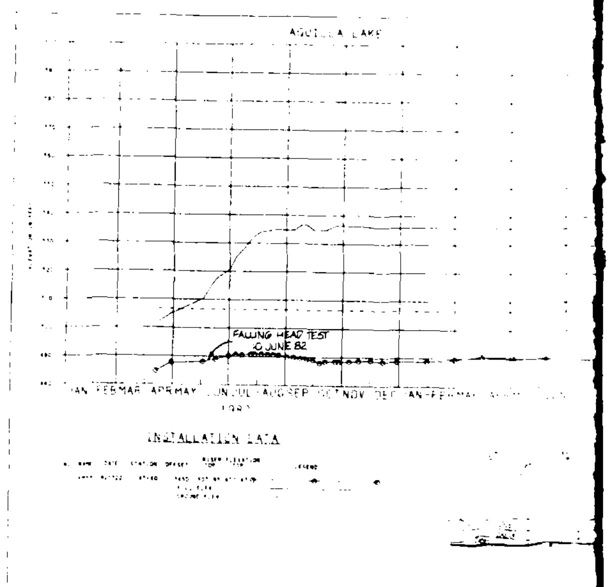
SEQUENCE NO

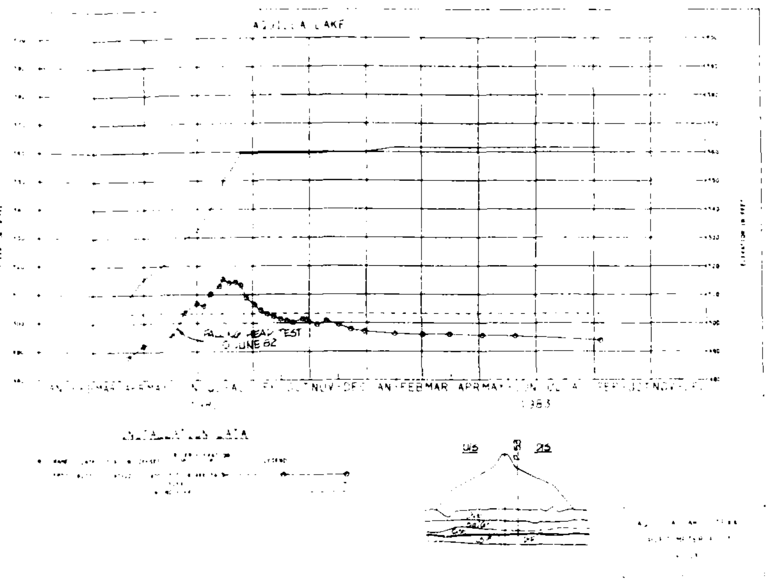
PLATE 43

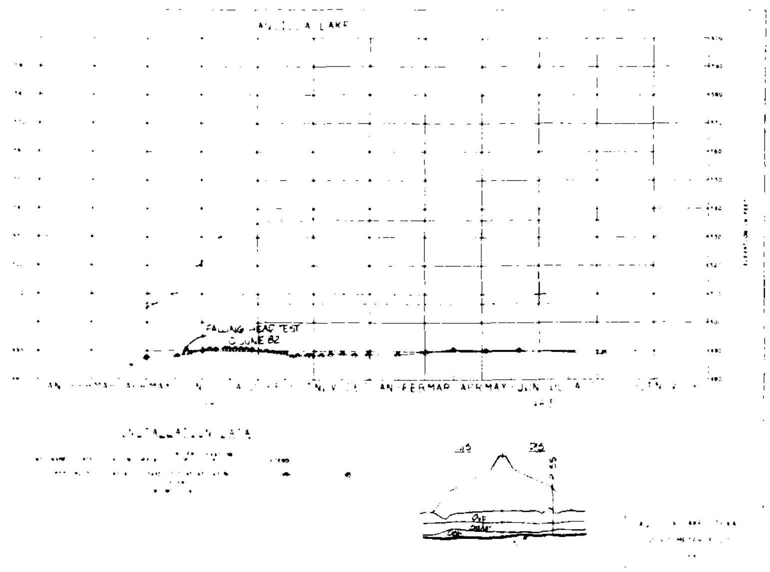

AQUILLA LAKE
FALLING HEAD TEST
10 JUNE 82
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1982
1983
INSTALLATION DATA
P-52


AQUILLA LAKE
FALLING HEAD TEST
10 JUNE 82
1982
INSTALLATION DATA


AQUILLA LAKE
FALLING HEAD TEST
10 JUNE 82
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1982
1983
INSTALLATION DATA
P-54
AQUILLA LAKE, TEXAS
PIEZOMETER PLOT
P-54


AQUILLA LAKE
FALLING HEAD TEST
10 JUNE 82
INSTALLATION DATA





NOTE: RISER TOP ELEVATION IS FOR BEGINNING OF READINGS.

LEGEND
OVB - OVERBURDEN
CSH - CLAY SHALE
GR - GRAVEL
S - SAND
SS - SANDSTONE
C - CLAY
LS - LIMESTONE
DR - DEL RIO

SYMBOL	ACTION	DATE	DESCRIPTION OF REVISION

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

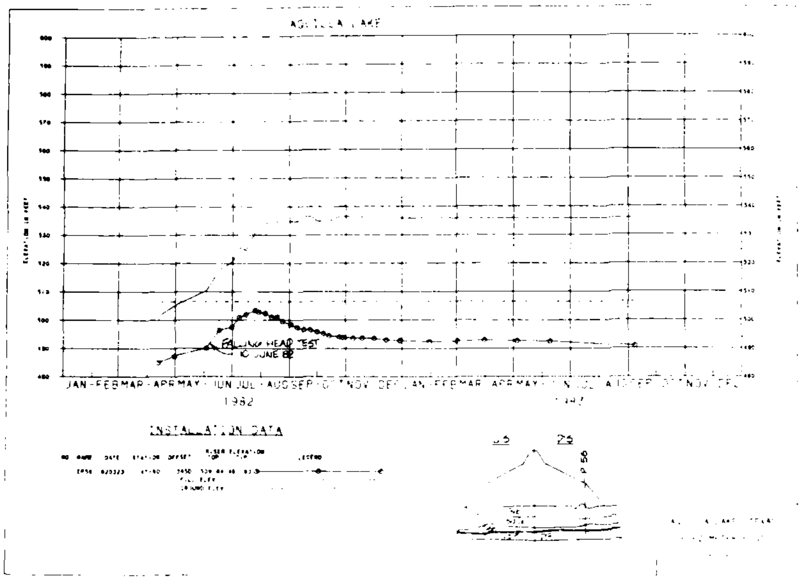
DESIGNED BY: N. BENNETT, R. GRISWOLD
DRAWN BY: F. WEDERSKINE
CHECKED BY: T. SCHMIDT

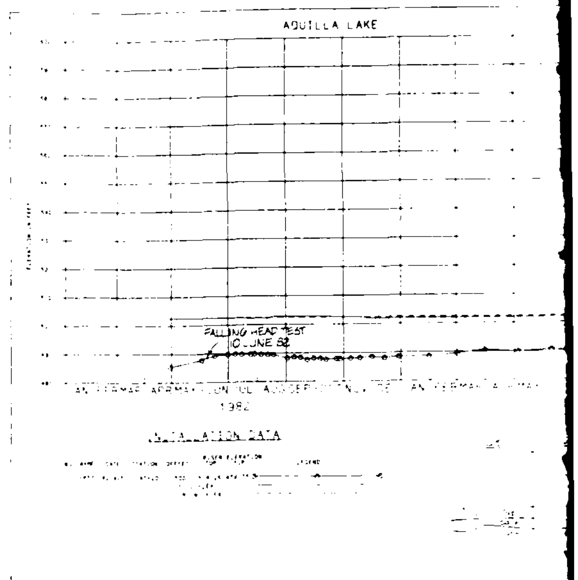
AQUILLA LAKE
PIEZOMETERS P-52, P-53, P-54 & P-55
PIEZOMETER AND FILL ELEVATION VS TIME

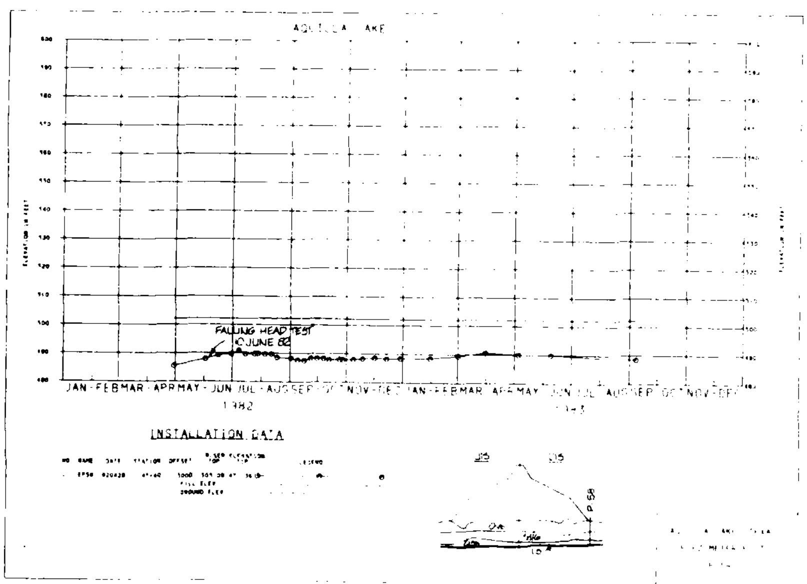
SUBMITTED BY: H.E. KARBS, ENGINEER

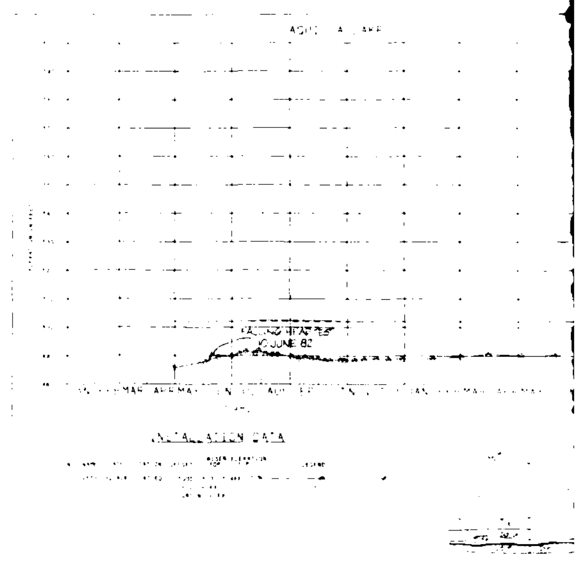
INV. NO | DATED
CONTR. NO
DRAWING NUMBER | SHEET NO. OF | SEQUENCE NO.

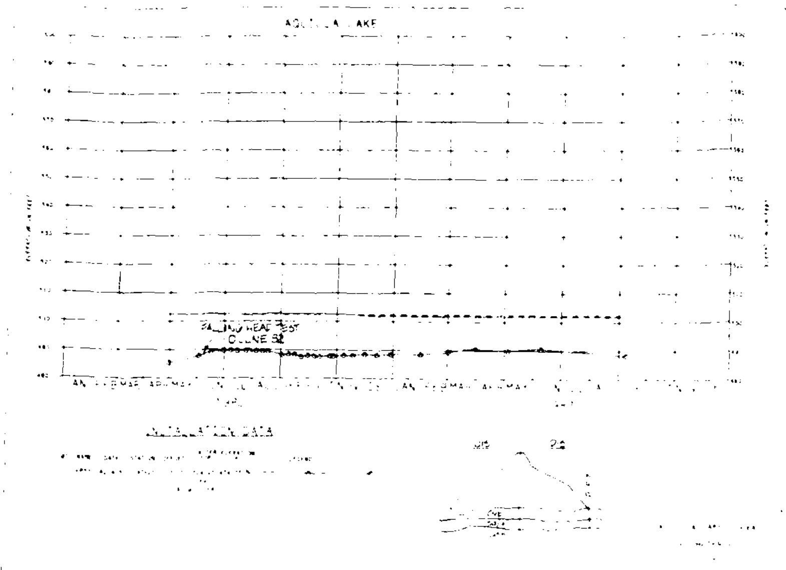
PLATE 49

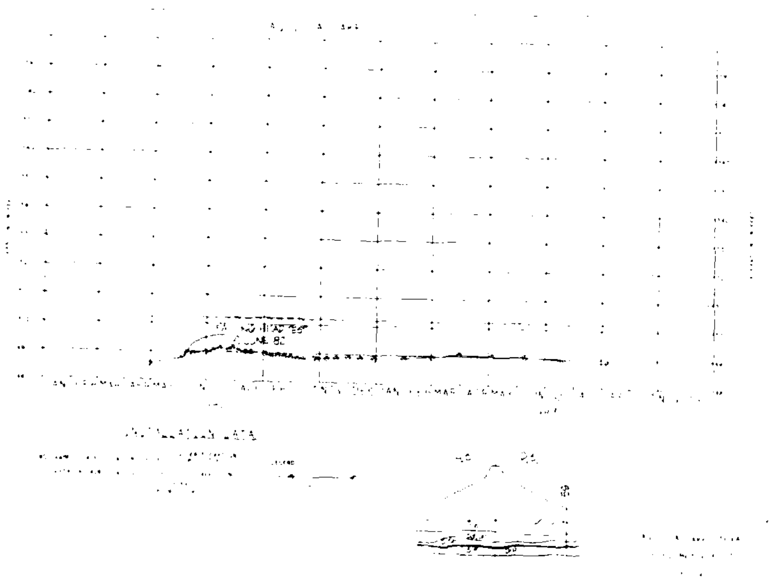

AQUILLA LAKE
FALLING HEAD TEST
10 JUNE 82
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1982
INSTALLATION DATA


AQUILLA LAKE
FALLING HEAD TEST
10 JUNE 82
1982
INSTALLATION DATA


AQUILLA LAKE
FALLING HEAD TEST
10 JUNE 82
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1982
INSTALLATION DATA


AQUILLA LAKE
FALLING HEAD TEST
10 JUNE 82
INSTALLATION DATA

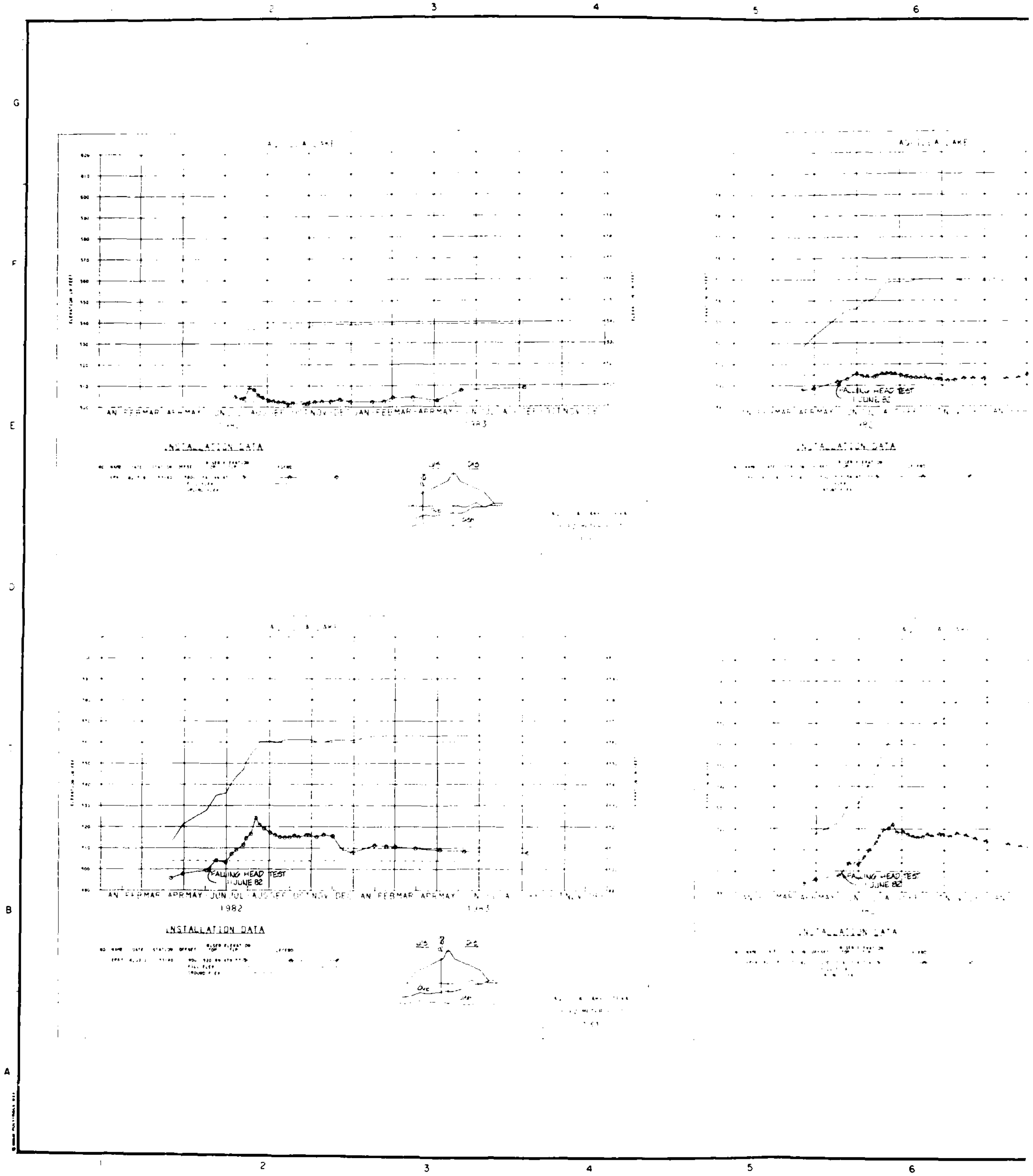


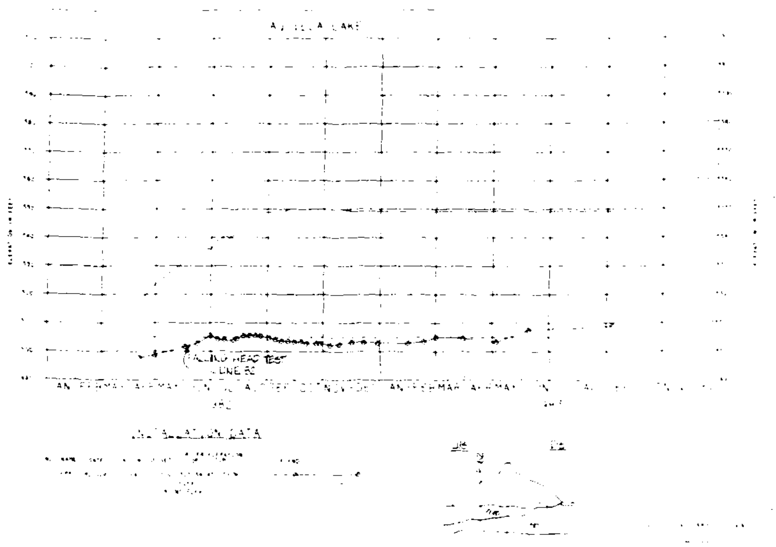


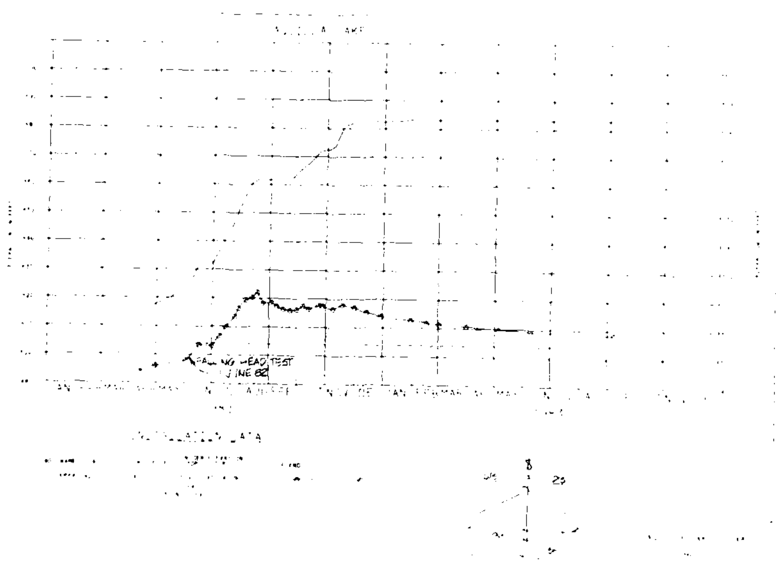
U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY: L. BENNETT	AQUILLA LAKE
DRAWN BY: K. HAWKYCHIKE	PIEZOMETERS P56, P57, P58, P59
CHECKED BY: L. SCHMIDT	PIEZOMETER AND FILL ELEVATION VS TIME
SUBMITTED BY: H.E. KARBS, ENGINEER	

PLATE 50


INSTALLATION DATA
FALLING HEAD TEST
JUNE 82
1982
INSTALLATION DATA
FALLING HEAD TEST
JUNE 82
INSTALLATION DATA
INSTALLATION DATA

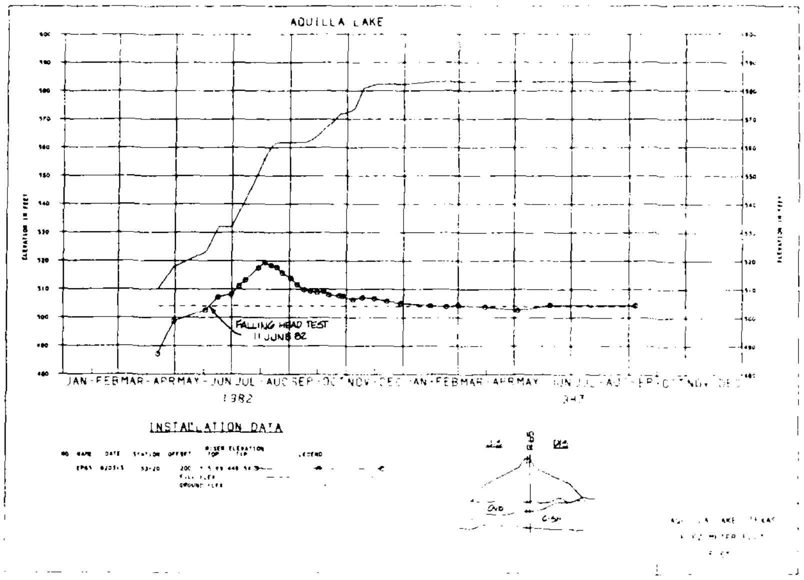


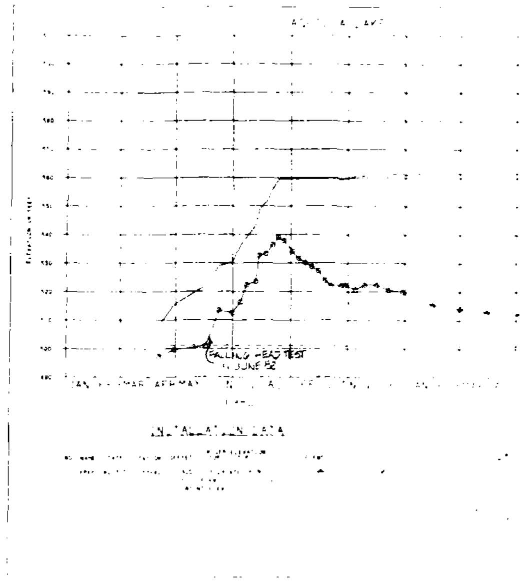


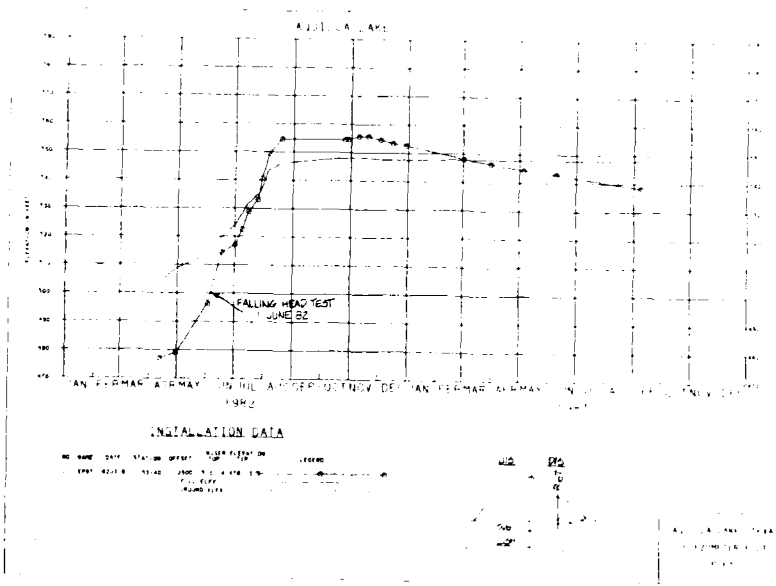
NOTE: [illegible] TIP ELEVATION [illegible] FOR BEGINNING OF READ[illegible]

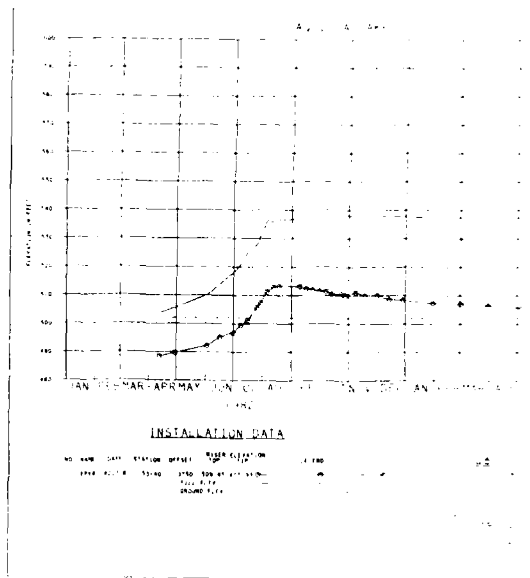
	U.S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS
DESIGNED BY: L. BENNETT [illegible]	AQUILLA LAKE PIEZOMETERS P61, P62, P63, P64 PIEZOMETER AND FILL ELEVATION VS TIME
DRAWN BY: F. [illegible]SHIRE	
[illegible]: T. SCHMIDT	
SUBMITTED BY: H.E. KARBS ENGINEER	INV. NO. / DATED / CONT'R NO. / DRAWING NUMBER / SHEET NO. OF / SEQUENCE NO.

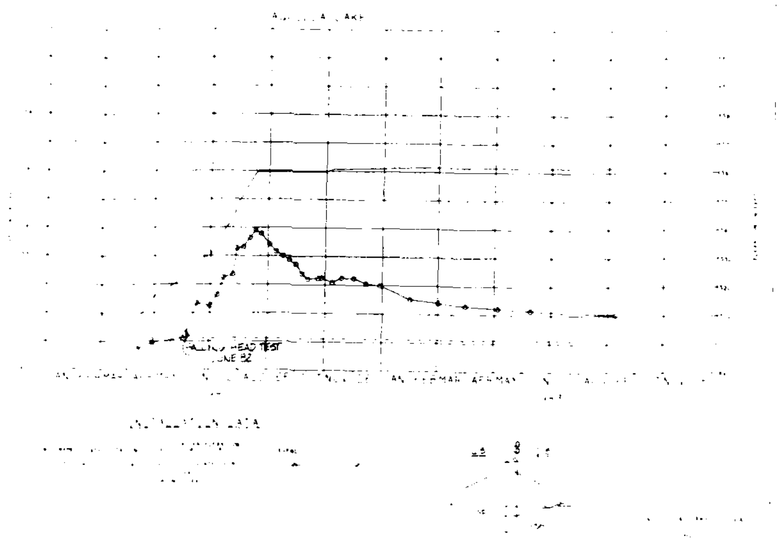
PLATE 51

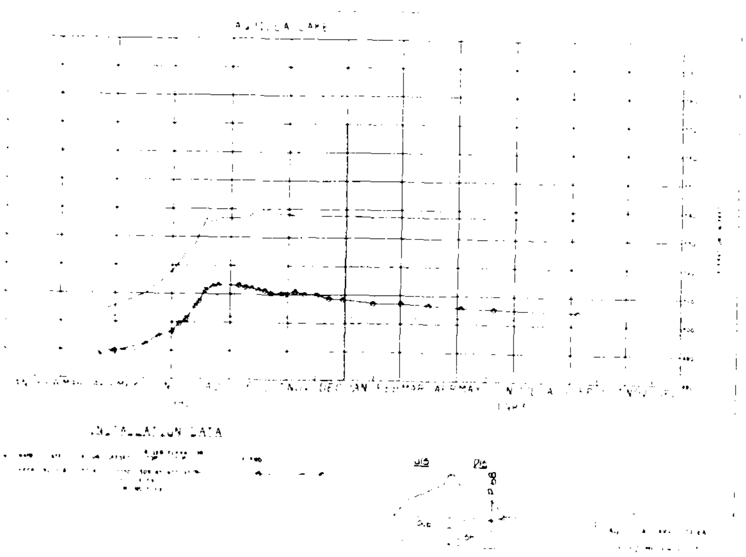

AQUILLA LAKE
ELEVATION IN FEET
FALLING HEAD TEST
11 JUNE 82
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1982
INSTALLATION DATA


FALLING HEAD TEST
11 JUNE 82
INSTALLATION DATA


AQUILLA LAKE
FALLING HEAD TEST
11 JUNE 82
1982
INSTALLATION DATA


INSTALLATION DATA





NOTE: RISER TOP ELEVATION IS FOR BEGINNING OF READINGS.

LEGEND

Ovb - OVERBURDEN
ClSh - CLAY SHALE
Gr - GRAVEL
Sd - SAND
SS - SANDSTONE
Cl - CLAY
LS - LIMESTONE
D/R - DEL RIO

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

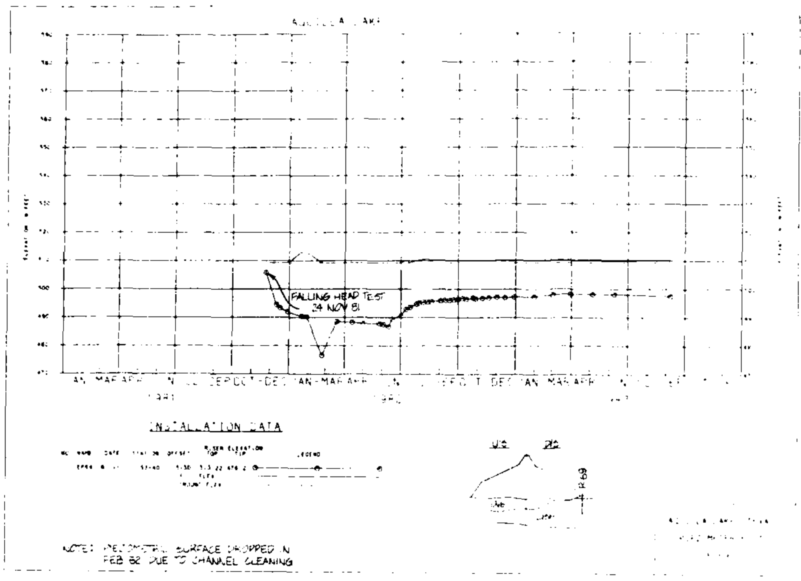
DESIGNED BY: U. BENNETT, K. GRISWOLD
DRAWN BY: K. BRYKESHIRE
CHECKED BY: T. SCHMIDT
SUBMITTED BY: H.E. KARBS, ENGINEER

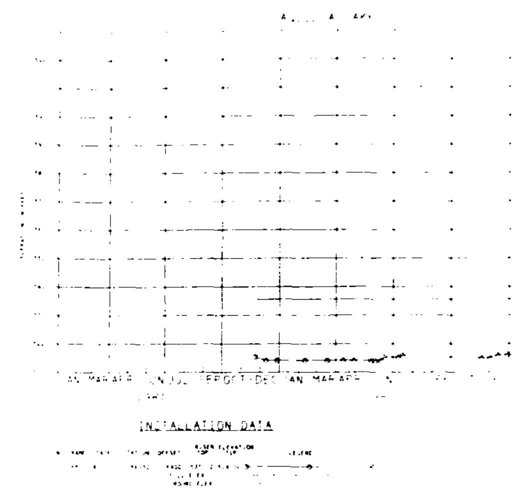
AQUILLA LAKE

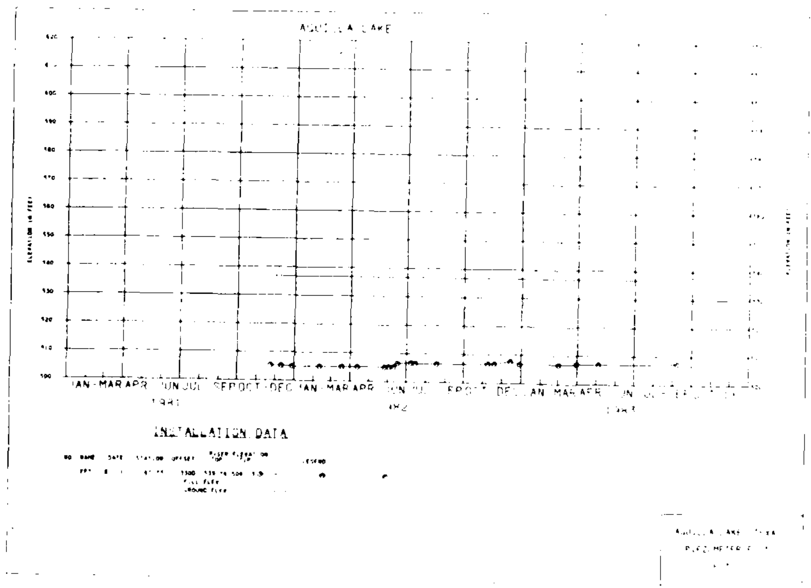
PIEZOMETERS P-65, P-66, P-67, P-68

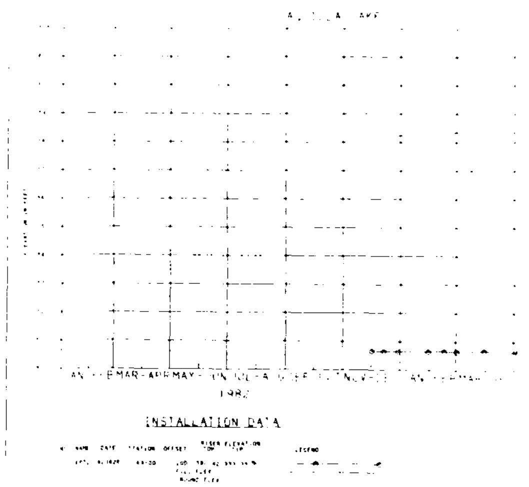
PIEZOMETER AND FILL ELEVATION VS TIME

PLATE 52

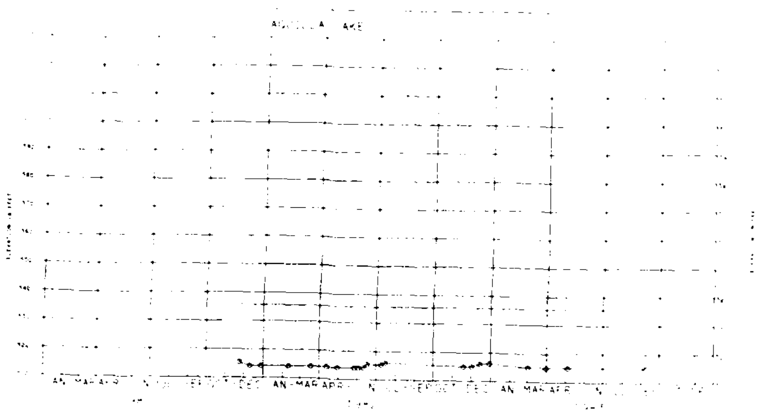

FALLING HEAD TEST
24 NOV 81
1981
INSTALLATION DATA
NOTE: PIEZOMETRIC SURFACE DROPPED IN
FEB 82 DUE TO CHANNEL CLEANING


INSTALLATION DATA


AGUILLA LAKE
1981
INSTALLATION DATA

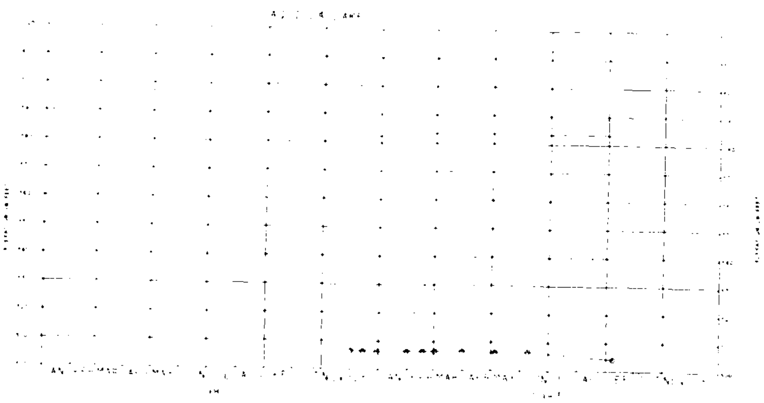

1982
INSTALLATION DATA

AQUILLA LAKE



INSTALLATION DATA

AQUILLA LAKE



INSTALLATION DATA

NOTE: RISER TOP ELEVATION ± FOR BEGINNING OF READINGS.

LEGEND

Ovb - OVERBURDEN
ClSh - CLAY SHALE
Gr - GRAVEL
Sd - SAND
SS - SANDSTONE
Cl - CLAY
LS - LIMESTONE
DR - DELRIO

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY: N. BENNETT, R. GRISWOLD

DRAWN BY: K. BROOKSHIRE

REVIEWED BY: T. SCHMIDT

SUBMITTED BY: H.E. KARBS, ENGINEER

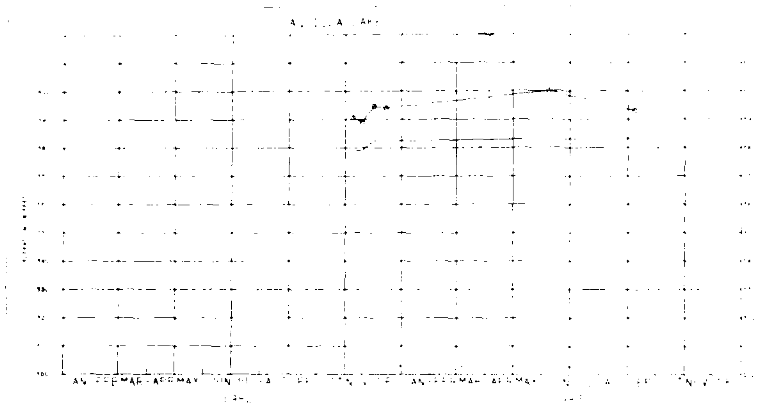
AQUILLA LAKE

PIEZOMETERS P-69 P-70 P-71, P-72

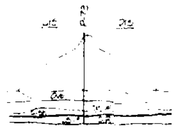
PIEZOMETER AND FILL ELEVATION VS TIME

INV. NO. | DATED | CONTR. NO. | DRAWING NUMBER | SHEET NO. OF | SEQUENCE NO.

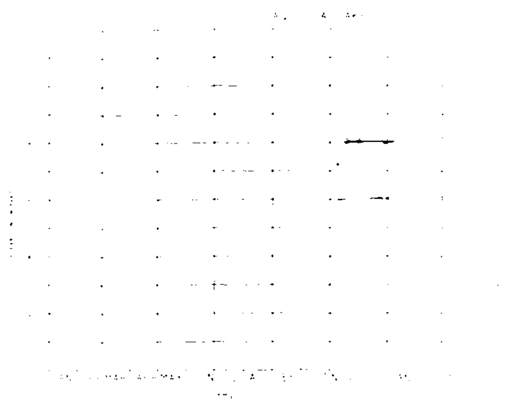
PLATE 53



INSTALLATION DATA

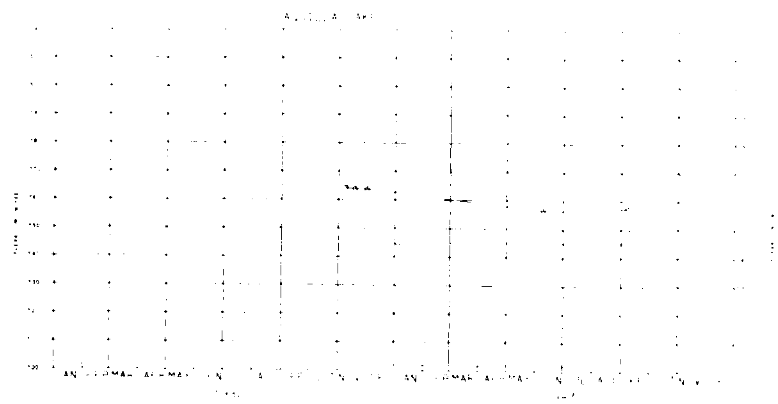


NOTE: PIEZOMETRIC SURFACE IS ABOVE FILL

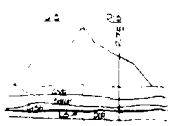


INSTALLATION DATA

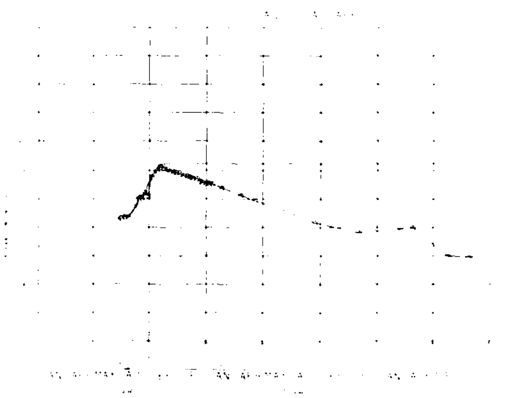
NOTE: PIEZOMETRIC SURFACE IS ABOVE FILL



INSTALLATION DATA

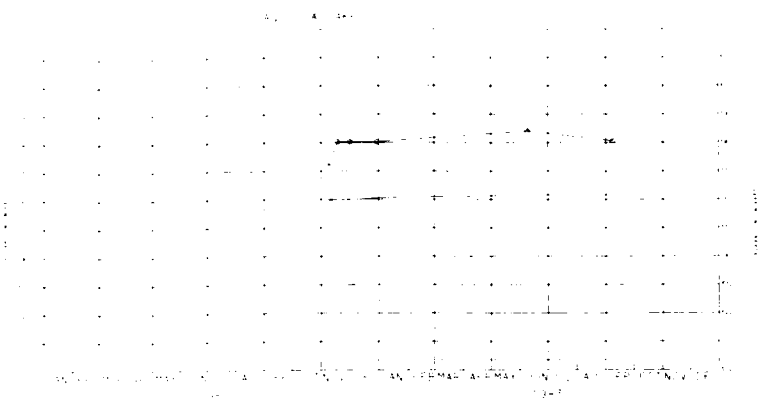


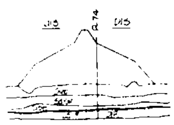
NOTE: PIEZOMETRIC SURFACE IS ABOVE FILL

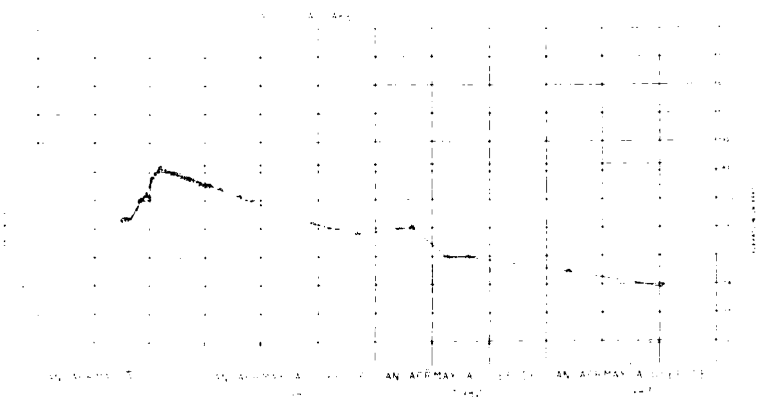


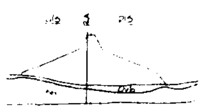
INSTALLATION DATA

NOTE: PIEZOMETRIC SURFACE CLOSELY FOLLOWS THE FILL ELEVATION BETWEEN JUN 80 TO SEP 80









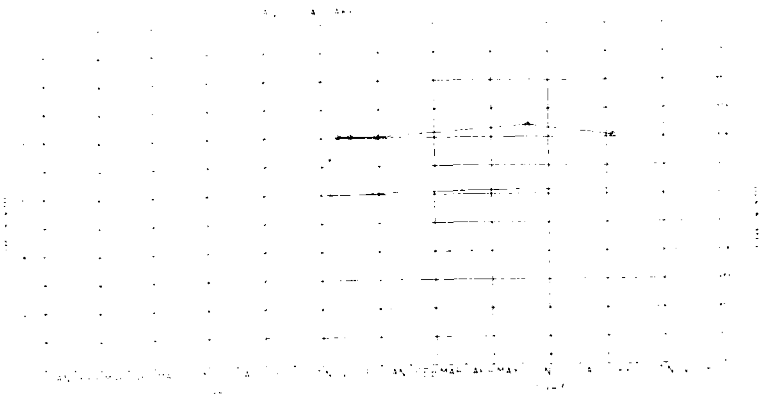
NOTE: RISER TOP ELEVATION FOR BEGINNING OF READINGS.

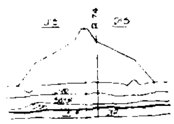
LEGEND

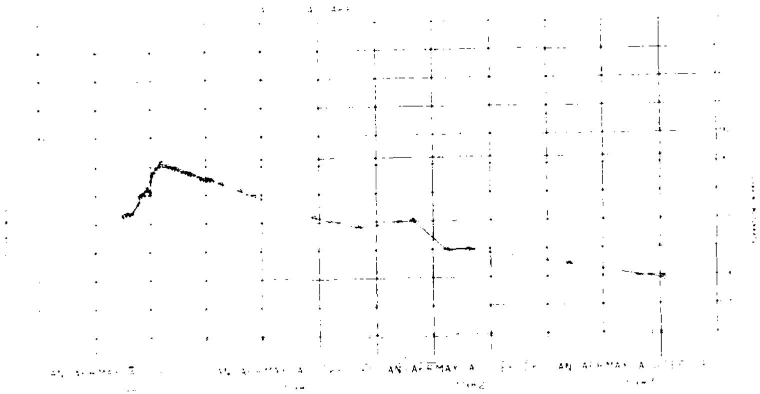
Ovb - OVERBURDEN
ClSh - CLAY SHALE
Gr - GRAVEL
Sd - SAND
SS - SANDSTONE
Cl - CLAY
LS - LIMESTONE
DR - DEL RIO

	U.S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS
DESIGNED BY L. BENNETT R. GRISWOLD	AQUILLA LAKE PIEZOMETERS P-73, P-74, P-75, P-A PIEZOMETER AND FILL ELEVATION VS TIME
DRAWN BY K. BROOKSHIRE	
CHECKED BY T. SCHMIDT	
SUBMITTED BY H.E. KARBS ENGINEER	NO. / DATED / CONTR NO / DRAWING NUMBER / SHEET NO OF / SEQUENCE NO

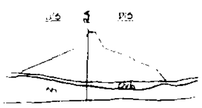
PLATE 54







NOTE: PIEZOMETER IS READ ... CLOSELY FOLLOWS THE FILL ELEVATION BETWEEN JUN 80 TO SEP 80



NOTE: RISER TOP ELEVATION IS FOR BEGINNING OF READINGS.

LEGEND
Ovb - OVERBURDEN
Cl Sh - CLAY SHALE
Gr - GRAVEL
Sd - SAND
SS - SANDSTONE
Cl - CLAY
LS - LIMESTONE
D.R. - DEL RIO

US ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY: J. BENNETT, P. GRISWOLD
DRAWN BY: J. BRODCHIRE
CHECKED BY: T. SCHMIDT
SUBMITTED BY: H.E. KARBS, ENGINEER

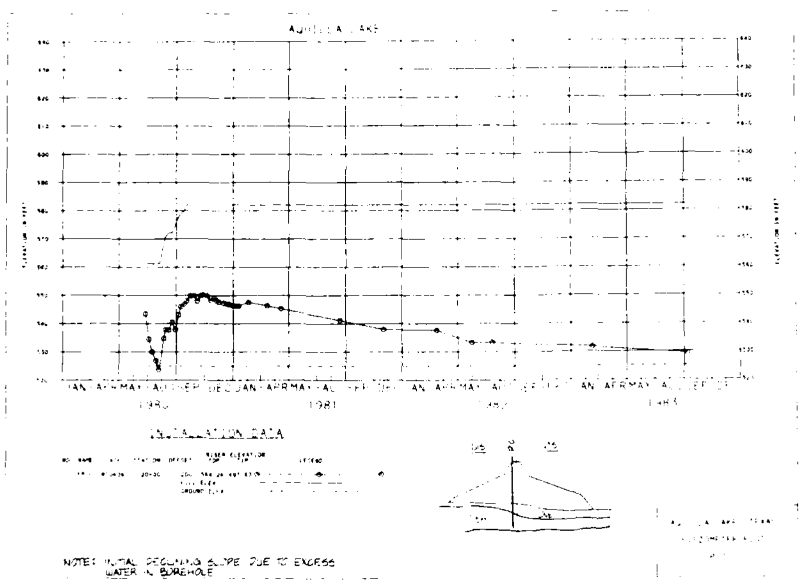
AQUILLA LAKE

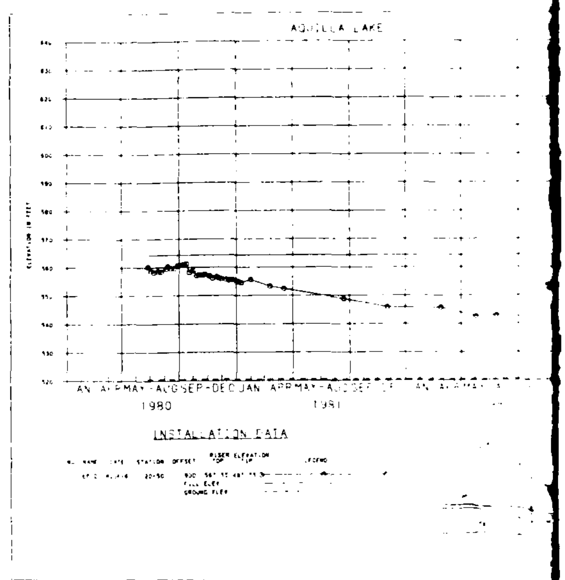
PIEZOMETERS P73, P74, P75, P-A

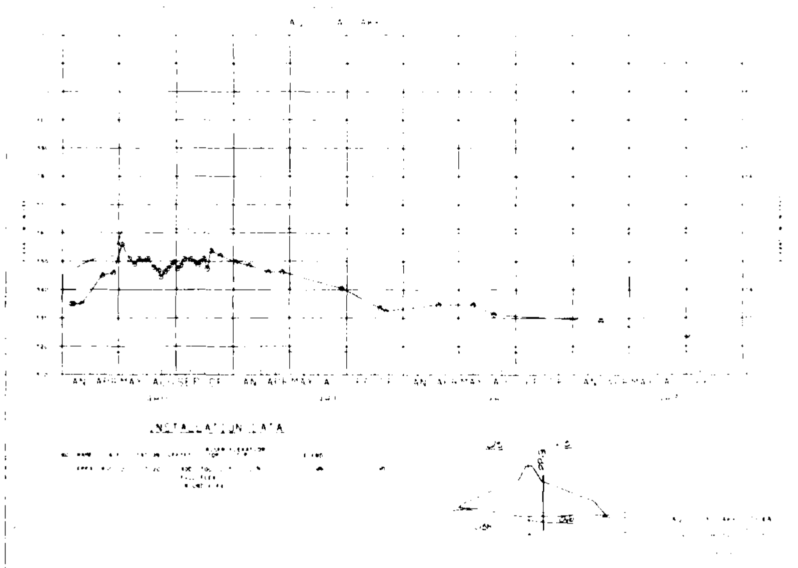
PIEZOMETER AND FILL ELEVATION VS TIME

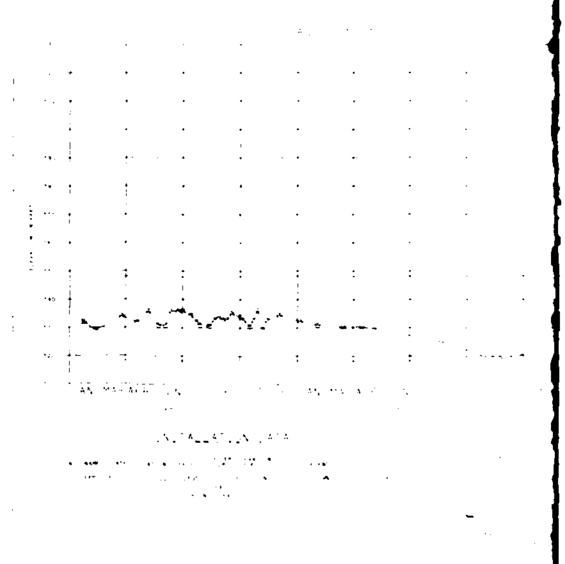
INV NO | DATED
CONTR NO
DRAWING NUMBER | SHEET NO OF
SEQUENCE NO

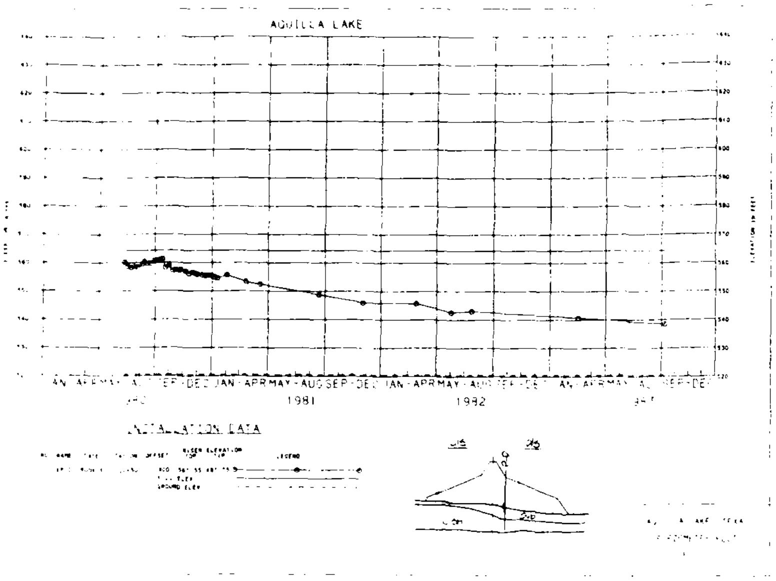
PLATE 54

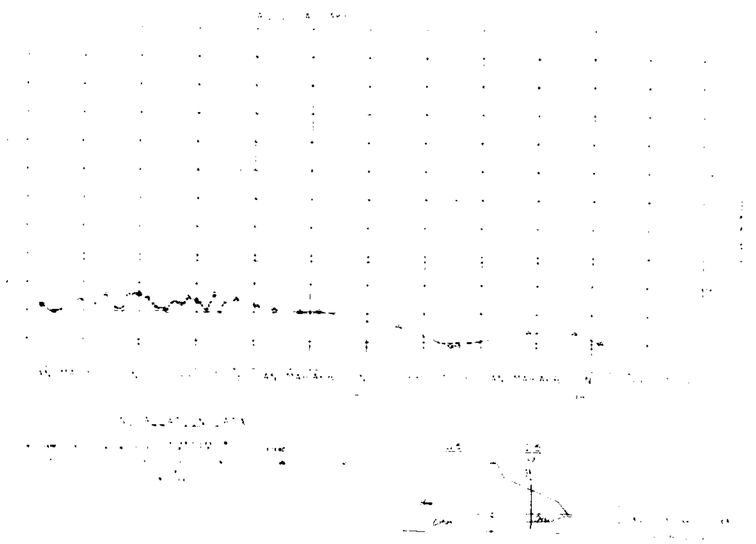

AQUILLA LAKE
1980
1981
INSTALLATION DATA
NOTE: INITIAL DECLINING SLOPE DUE TO EXCESS WATER IN BOREHOLE


AQUILLA LAKE
1980
1981
INSTALLATION DATA


INSTALLATION DATA







NOTE: RISER TOP ELEVATION IS FOR BEGINNING OF READINGS.

LEGEND
Ovb - OVERBURDEN
ClSh - CLAY SHALE
Gr - GRAVEL
Sd - SAND
SS - SANDSTONE
C - CLAY
LS - LIMESTONE
DR - DEL RIO

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY N. HEWITT, R. GRISWOLD
DRAWN BY K. BERKSHIRE
CHECKED BY T. SCHMIDT
SUBMITTED BY H.E. KARBS, ENGINEER

AQUILLA LAKE
PIEZOMETERS P-C, P-D, PR9, PP-10
PIEZOMETER AND FILL ELEVATION VS TIME

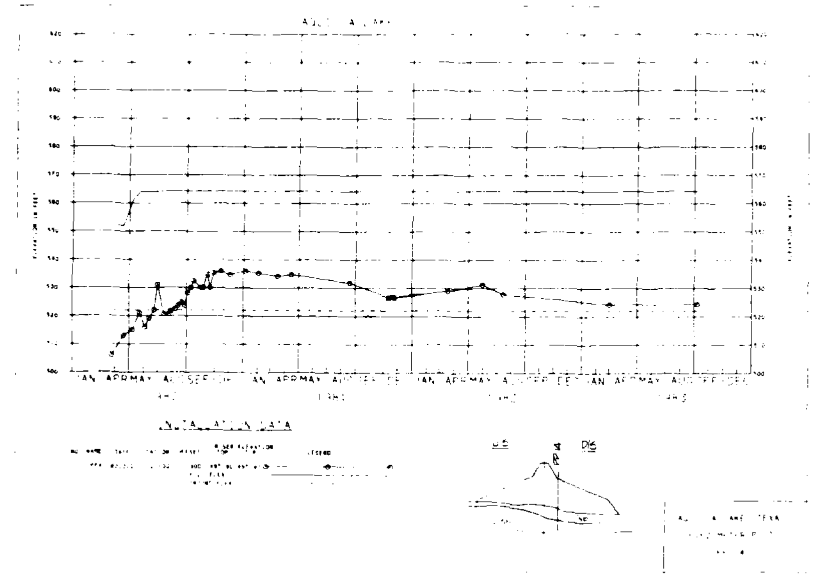
INV. N | DATED | CONT. NO | DRAWING NUMBER | SHEET NO OF | SEQUENCE NO

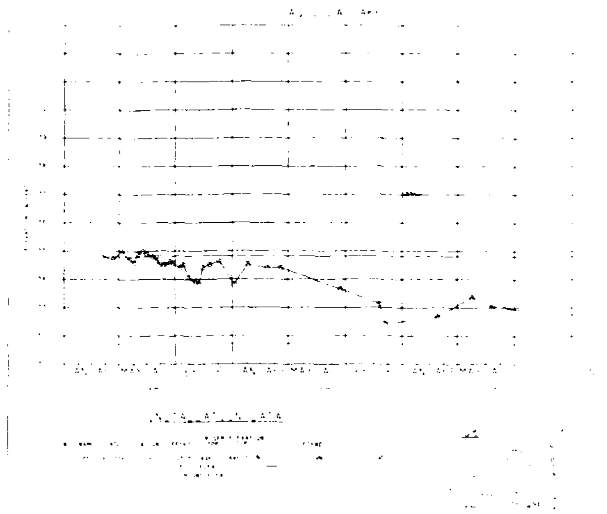
2 3 4 5 6

G

F

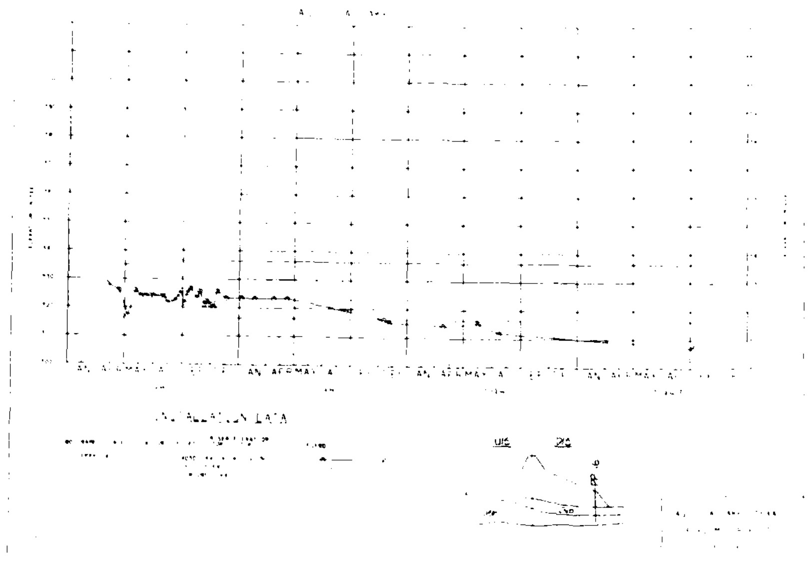
E

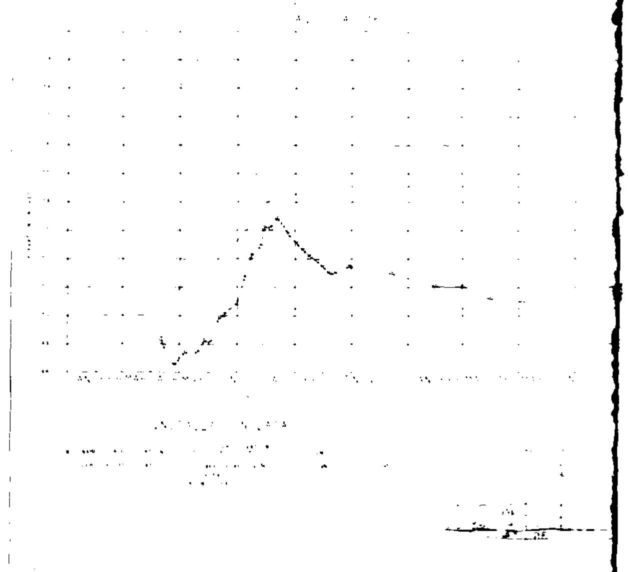




D

C

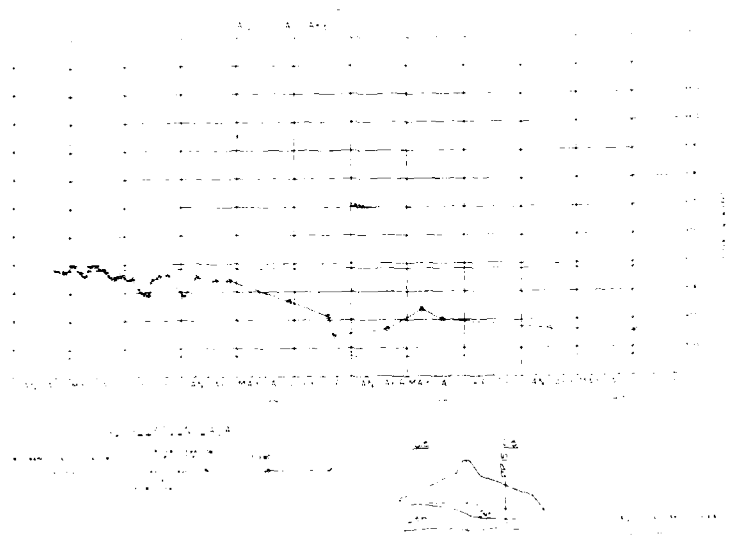


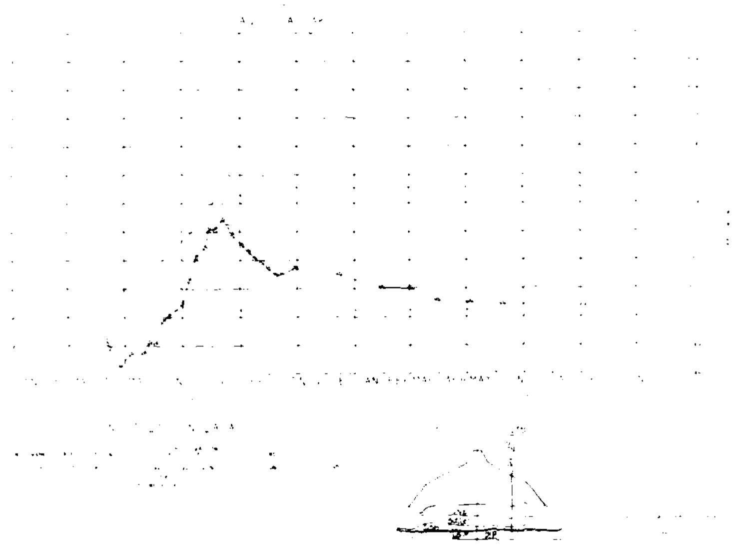


B

A

1 2 3 4 5 6 7





NOTE: RISER TOP ELEVATION IS FOR BEGINNING OF READINGS.

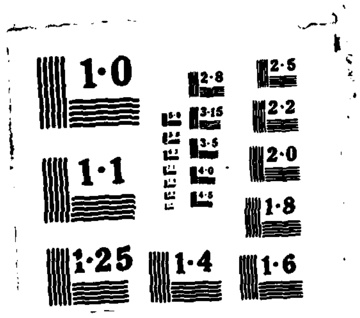
LEGEND
Ovb - OVERB. FORM.
CSh - CLAY SHALE
Gr - GRAVEL
Sd - SAND
SS - SANDSTONE
C - CLAY
LS - LIMESTONE
D.R. - DEL RIO

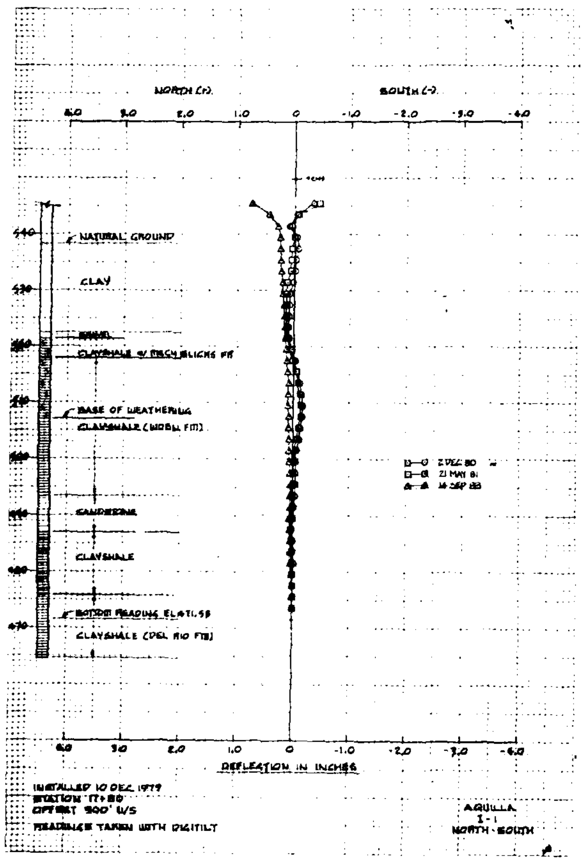
	U.S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS
DESIGNED BY	AQUILLA LAKE PIEZOMETERS PR-14, PR-15, PR-16, PR-25 PIEZOMETER AND FILL ELEVATION VS TIME
DRAWN BY	
CHECKED BY	
SUBMITTED BY H. E. KARBS, ENGINEER	INV NO / DATED / CONTR NO / DRAWING NUMBER / SHEET NO / SEQUENCE NO

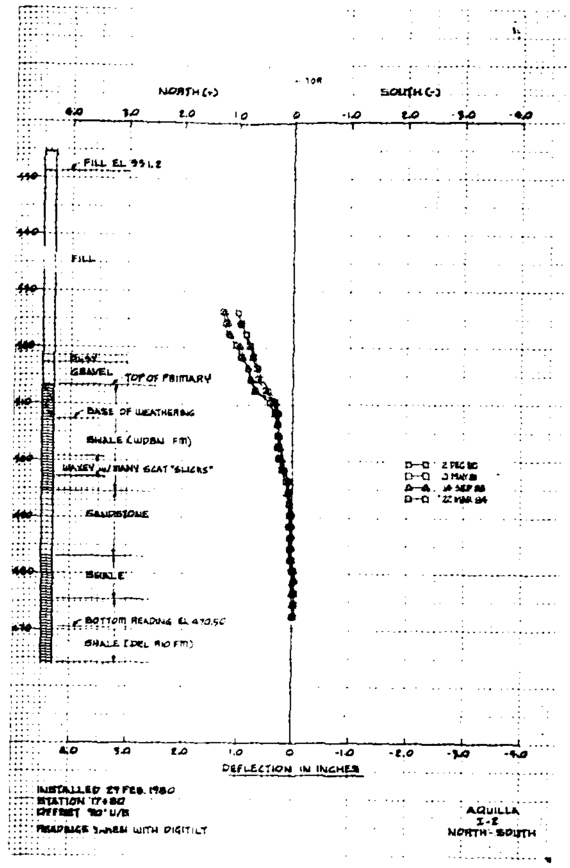
PLATE 56

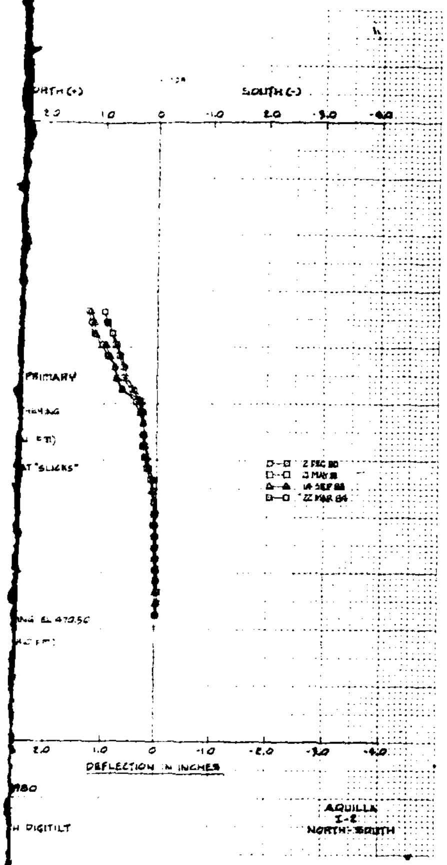
AD-A168 214   EMBANKMENT CRITERIA AND PERFORMANCE REPORT AQUILLA LAKE AQUILLA CREEK TEXAS BRAZOS RIVER BASIN(U) ARMY ENGINEER DISTRICT FORT WORTH TX DEC 85   3/3

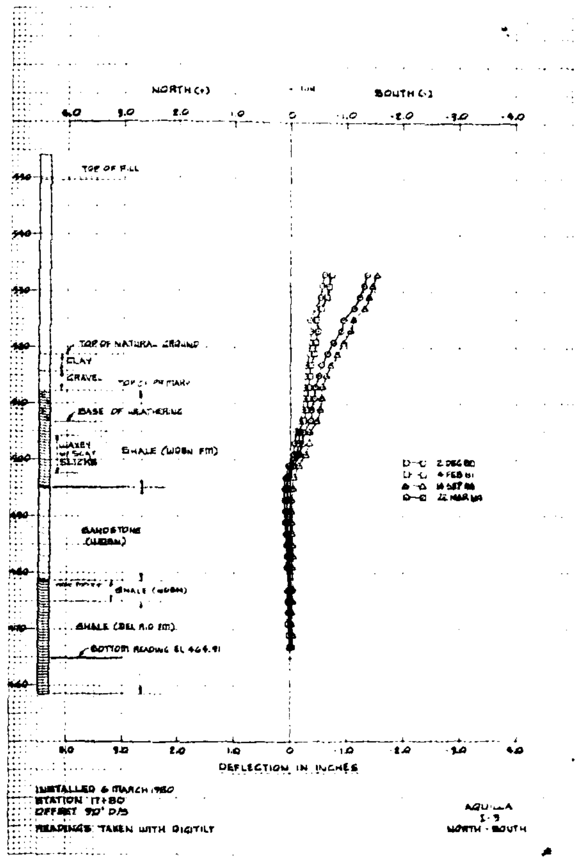
UNCLASSIFIED   F/G 13/2   NL


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.15
3.5
4.0
4.5


NORTH (+)
SOUTH (-)
NATURAL GROUND
CLAY
BASE OF WEATHERING
SANDSTONE
CLAYSHALE
CLAYSHALE (DEL RIO FM)
21 MAY 81
DEFLECTION IN INCHES
INSTALLED 10 DEC. 1979
STATION 17+80
OFFSET 500' U/S
READINGS TAKEN WITH DIGITILT
AQUILLA
I-1
NORTH-SOUTH


NORTH (+)
SOUTH (-)
FILL EL 951.2
FILL
GRAVEL
TOP OF PRIMARY
BASE OF WEATHERING
SHALE (WOBU FM)
SANDSTONE
BOTTOM READING EL 470.5C
SHALE (DEL RIO FM)
22 MAR 84
DEFLECTION IN INCHES
INSTALLED 29 FEB. 1980
STATION 17+80
OFFSET 90' U/S
READINGS TAKEN WITH DIGITILT
AQUILLA
I-2
NORTH-SOUTH





U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

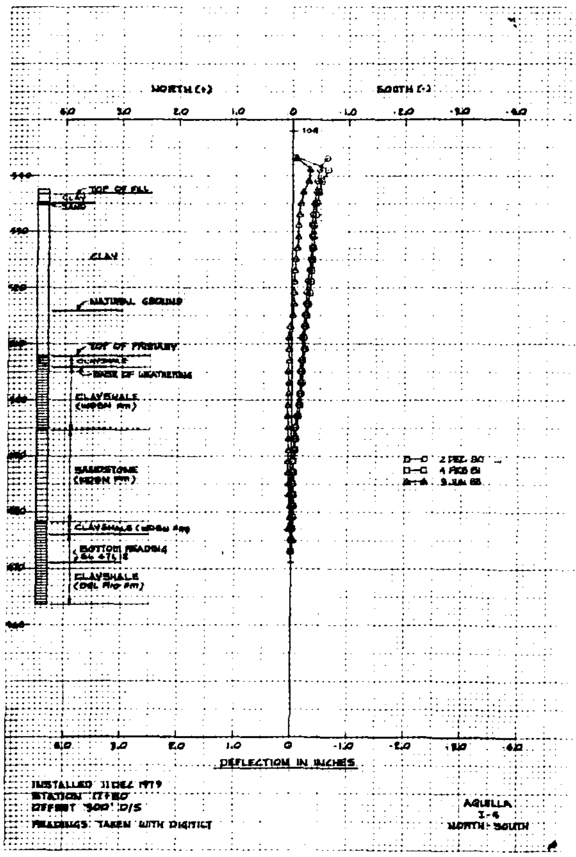
AQUILLA LAKE
AQUILLA CREEK, TEXAS

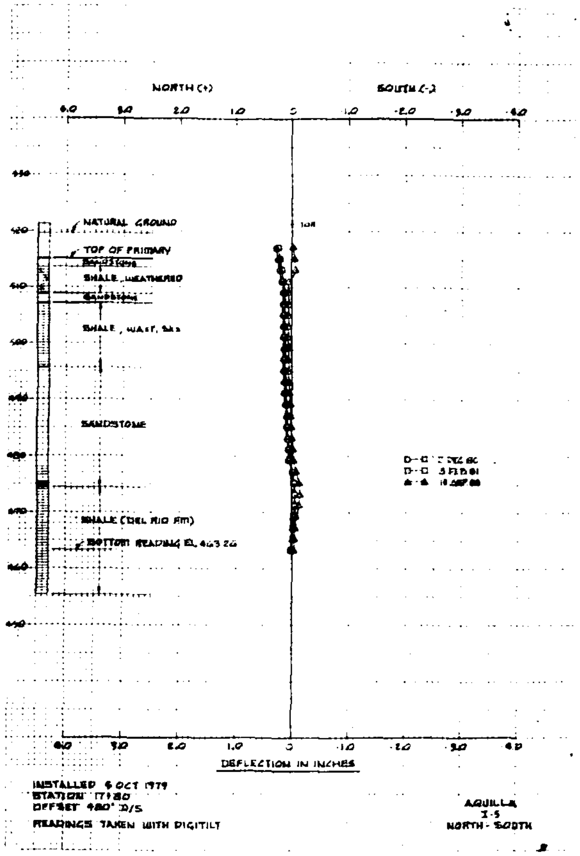
INCLINOMETERS

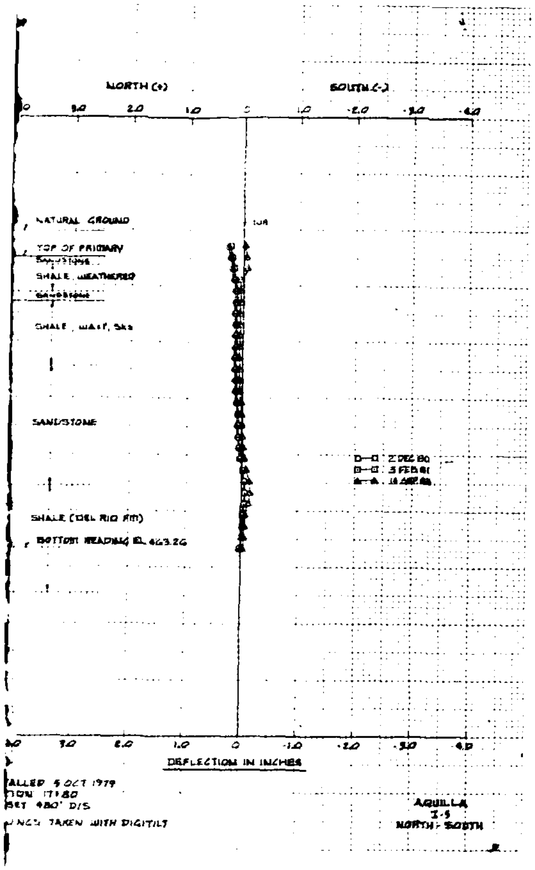
I-1, I-2, I-3

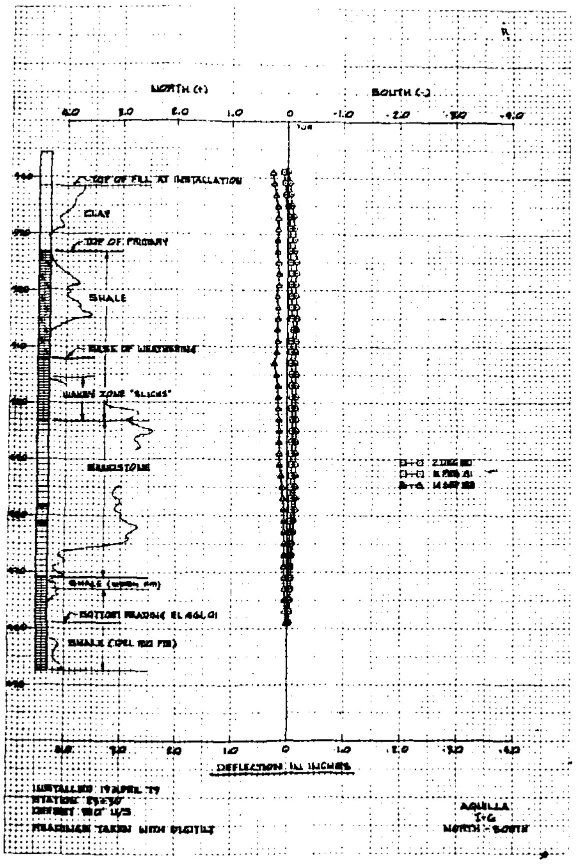
DESIGNED BY	
DRAWN BY	
CHECKED BY	T. SCHMIDT
SUBMITTED BY	H. L. KAPP
INV NO	DATED
CONTR NO	SEQUENCE NO
DRAWING NUMBER	SHEET NO OF

PLATE 57


NORTH (+)
SOUTH (-)
TOP OF FILL
CLAY
NATURAL GROUND
TOP OF PRIMARY
CLAYSHALE (DEL RIO FM)
DEFLECTION IN INCHES
INSTALLED 11 DEC 1979
STATION 17+80
OFFSET 300' D/S
READINGS TAKEN WITH DIGITILT
AQUILLA
I-4
NORTH - SOUTH


NORTH (+)
SOUTH (-)
NATURAL GROUND
TOP OF PRIMARY
SHALE, WEATHERED
SANDSTONE
SHALE (DEL RIO FM)
DEFLECTION IN INCHES
INSTALLED 6 OCT 1979
STATION 17+80
OFFSET 480' D/S
READINGS TAKEN WITH DIGITILT
AQUILLA
I-5
NORTH - SOUTH





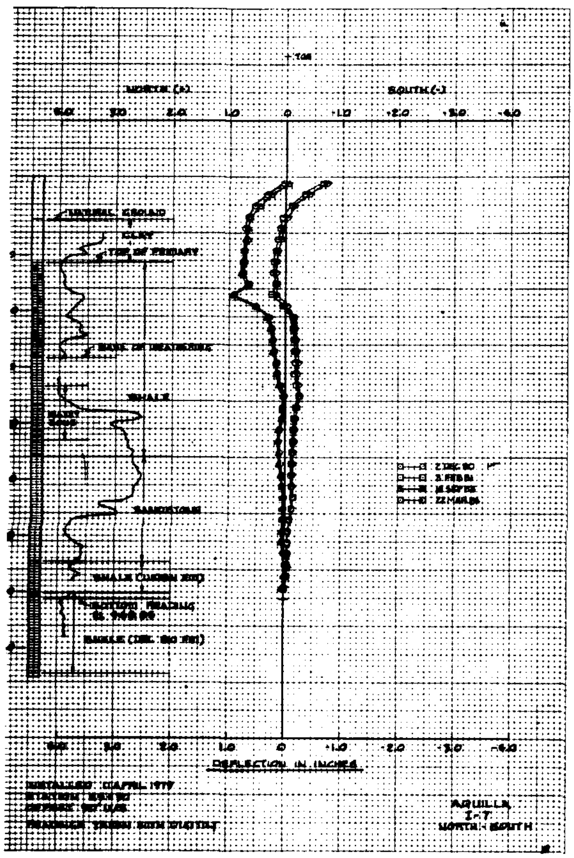
U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

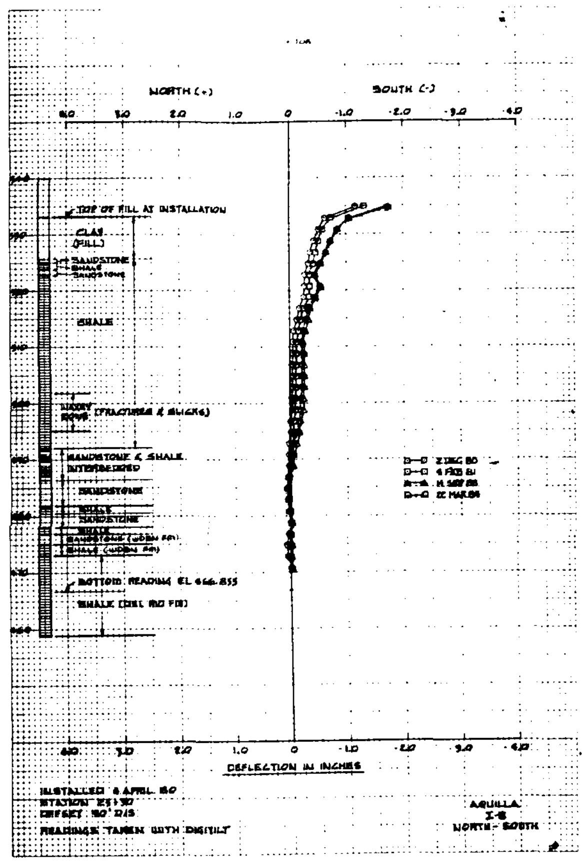
AQUILLA LAKE
AQUILLA CREEK TEXAS

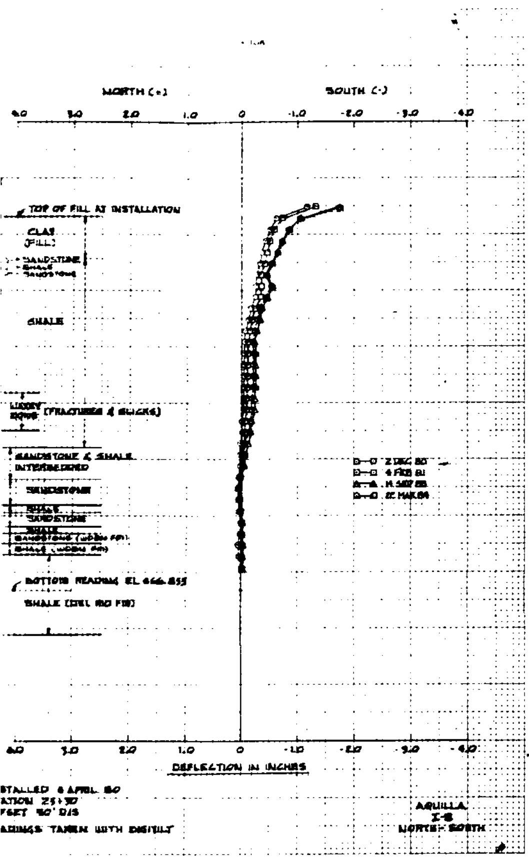
INCLINOMETERS
I-4, I-5, I-6

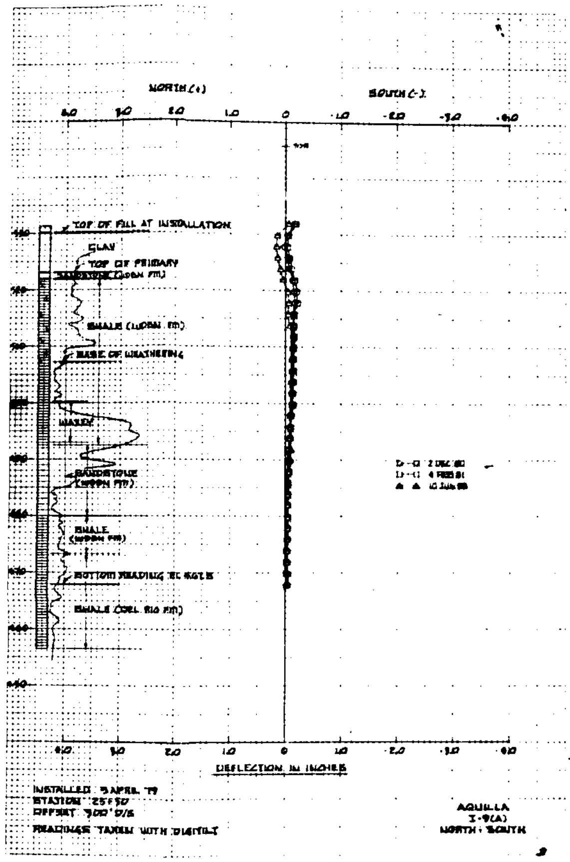
DESIGNED BY	N. BENNETT, P. GRISWOLD
DRAWN BY	V. BROOKSHIRE
SUBMITTED BY	H. E. KARBY, ENGINEER
INV NO	DATED
CONTR NO	
DRAWING NUMBER	SHEET NO OF

PLATE


NORTH (+)
SOUTH (-)
SHALE
SANDSTONE
DEFLECTION IN INCHES
AQUILLA
I-7
NORTH - SOUTH


NORTH (+)
SOUTH (-)
TOP OF FILL AT INSTALLATION
CLAY
(FILL)
SANDSTONE
SHALE
(FRACTURES & SLICKS)
SANDSTONE & SHALE INTERBEDDED
DEFLECTION IN INCHES
READINGS TAKEN WITH DIGITILT
AQUILLA
I-8
NORTH - SOUTH





US ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY N. BENNETT, R. GRISOLD

DRAWN BY K. BROOKSHIRE

CHECKED BY T. SCHMIDT

AQUILLA LAKE
AQUILLA CREEK, TEXAS

INCLINOMETERS

I-7 I-8 I-9

SUBMITTED BY H.E. KAPPS, ENGINEER

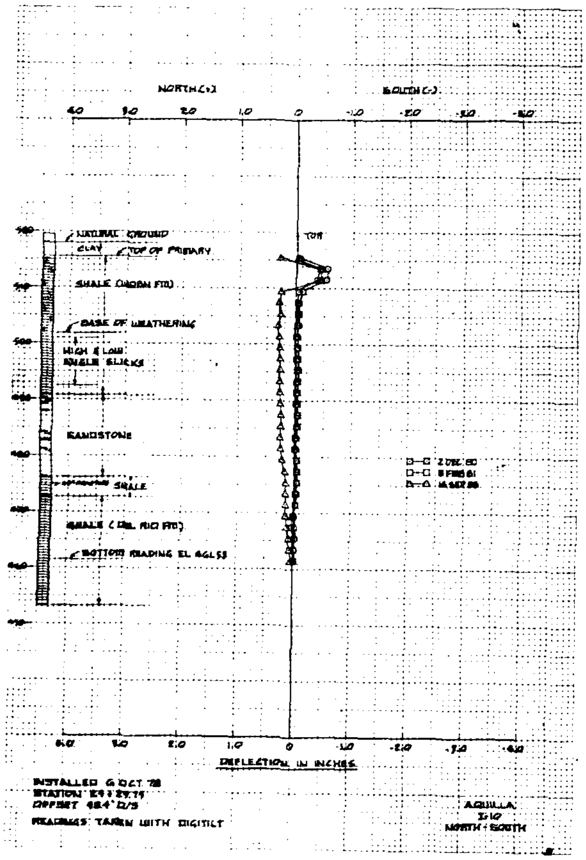
DATED

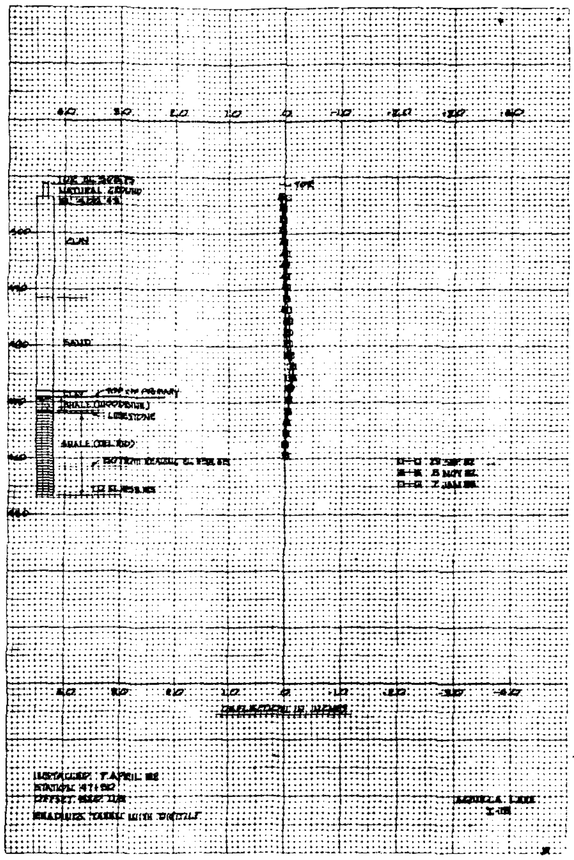
DRAWING NUMBER

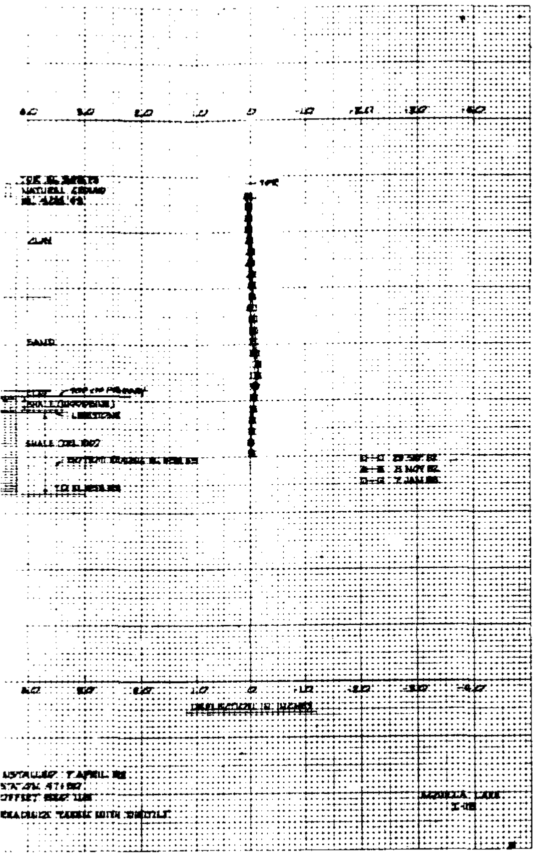
SHEET NO. OF

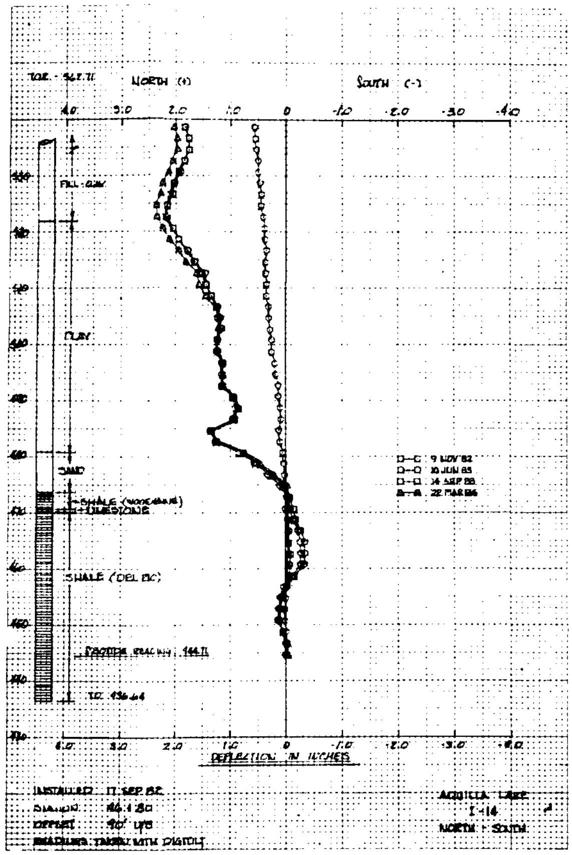
SEQUENCE NO.

PLATE


NORTH (+)
SOUTH (-)
NATURAL GROUND
CLAY
TOP OF PRIMARY
SHALE
BASE OF WEATHERING
HIGH & LOW
SANDSTONE
SHALE
BOTTOM READING
TOP
DEFLECTION IN INCHES
INSTALLED 6 OCT 78
READINGS TAKEN WITH DIGITILT
AQUILLA
NORTH - SOUTH


TOP
NATURAL GROUND
CLAY
SAND
TOP OF PRIMARY
LIMESTONE
BOTTOM READING
AQUILLA LAKE





U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

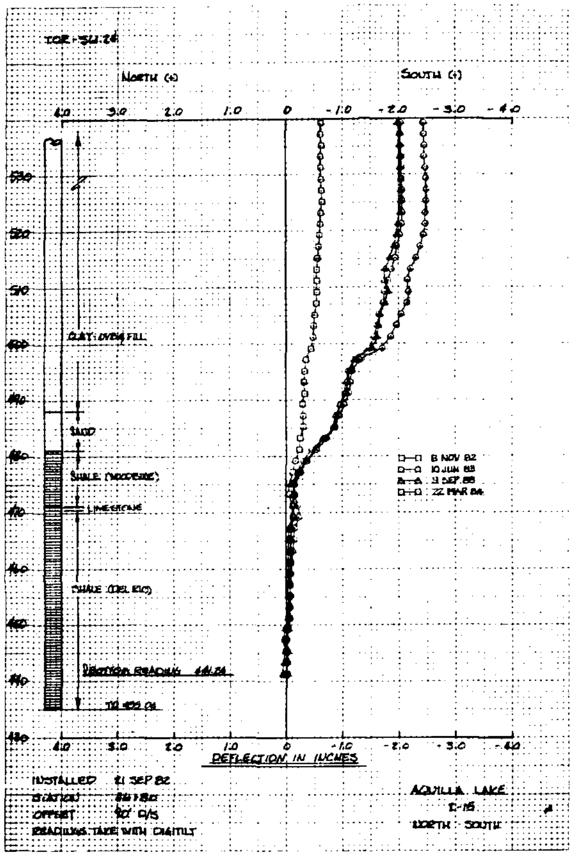
DESIGNED BY: N. BENNETT, P. GRISWOLD

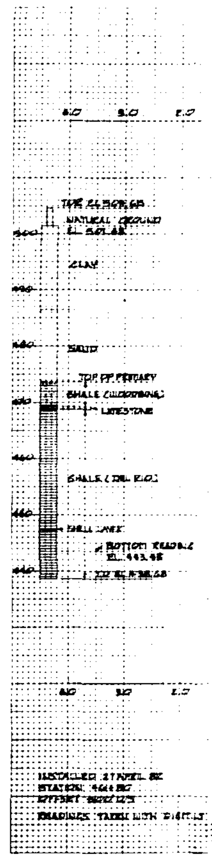
CHECKED BY: T. SCHMIDT

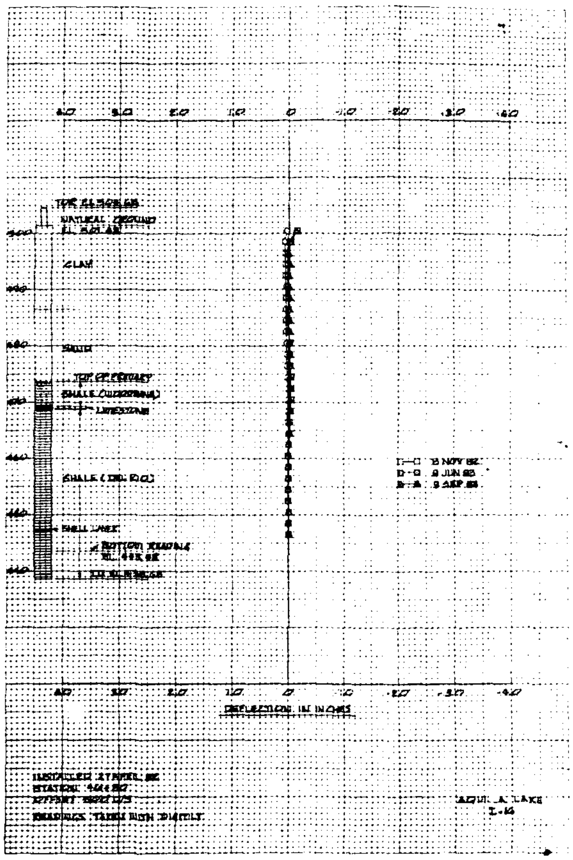
AQUILLA LAKE
AQUILLA CREEK, TEXAS

INCLINOMETERS
I-10, I-13, I-14

SUBMITTED BY: H.E. KARBS
ENGINEER


North (+)
South (-)
4.0 3.0 2.0 1.0 0 -1.0 -2.0 -3.0 -4.0
CLAY: OVER FILL
SAND
SHALE (WOODBINE)
LIMESTONE
SHALE (DEL RIO)
B NOV 82
10 JUN 83
22 MAR 84
DEFLECTION IN INCHES
INSTALLED 21 SEP 82
OFFSET 90' D/S
READINGS TAKE WITH DIGITILT
AQUILLA LAKE
I-15
NORTH - SOUTH


CLAY
SAND
LIMESTONE
BOTTOM READING
READINGS TAKEN WITH DIGITILT



U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

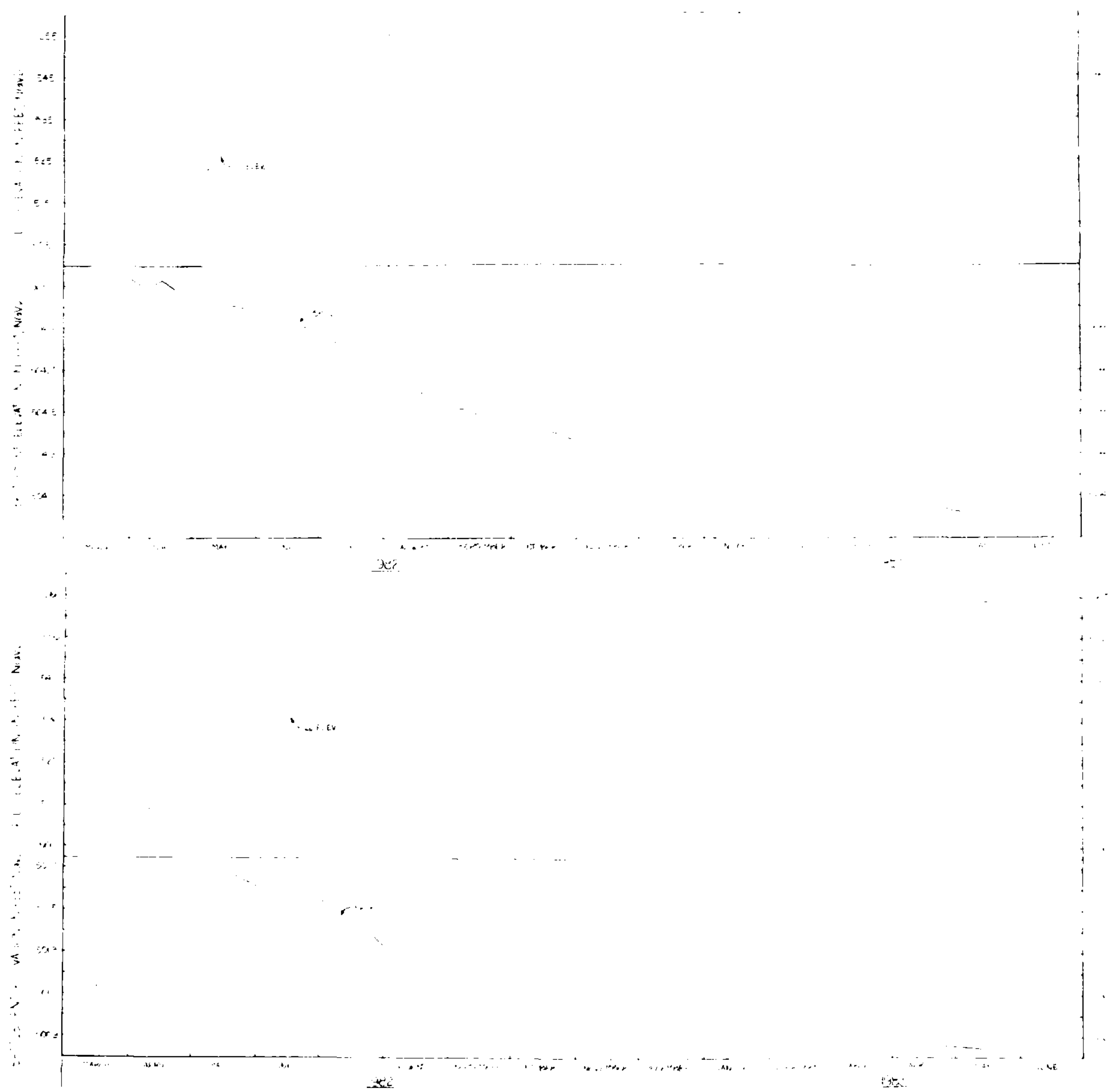
AQUILLA LAKE
AQUILLA CREEK, TEXAS

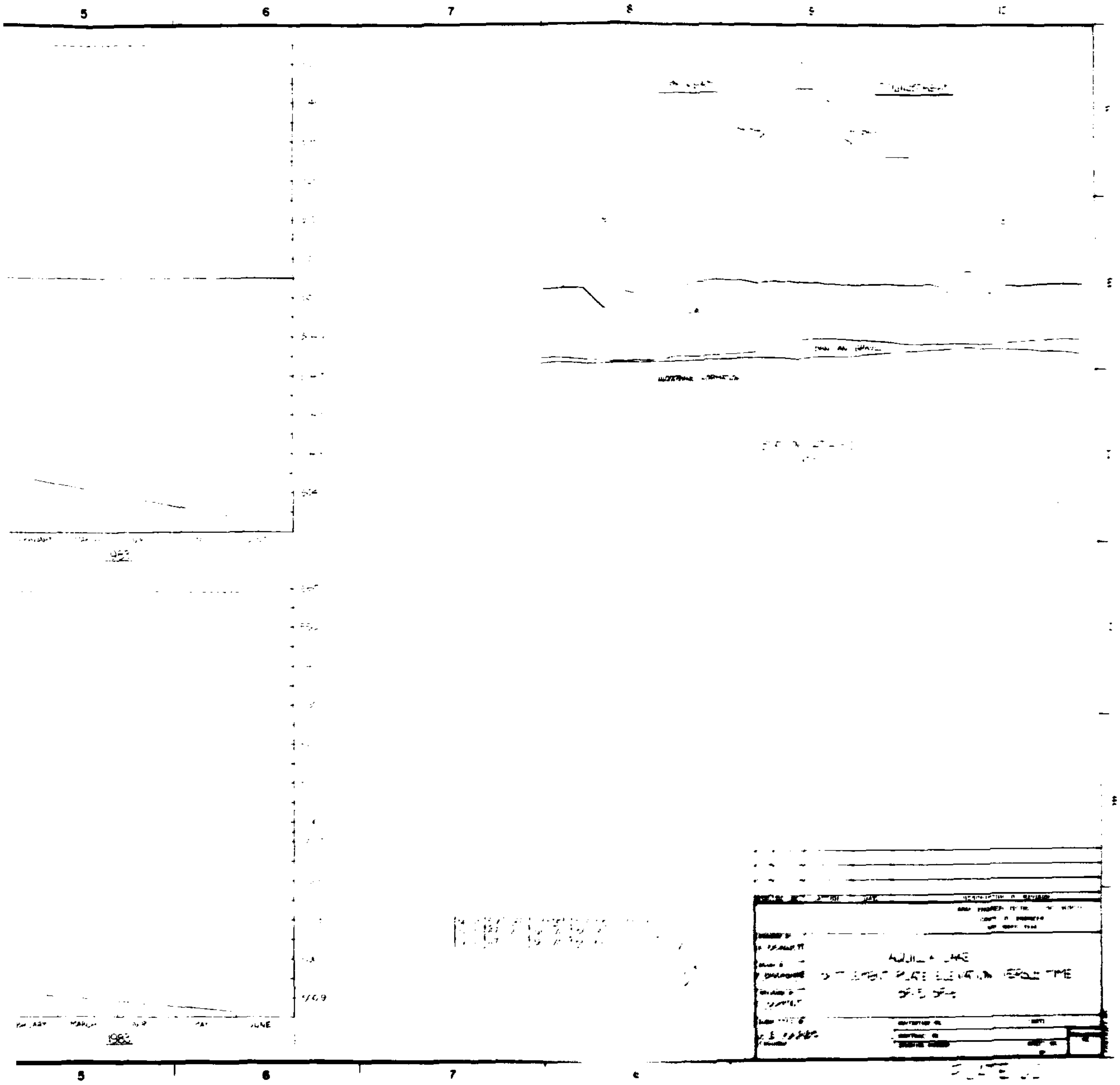
INCLINOMETERS
I-15, I-16

DESIGNED BY	SUBMITTED BY: H.E. KAPP, ENGINEER	INV NO / DATED
DRAWN BY		CONTR NO
CHECKED BY		DRAWING NUMBER / SHEET NO OF

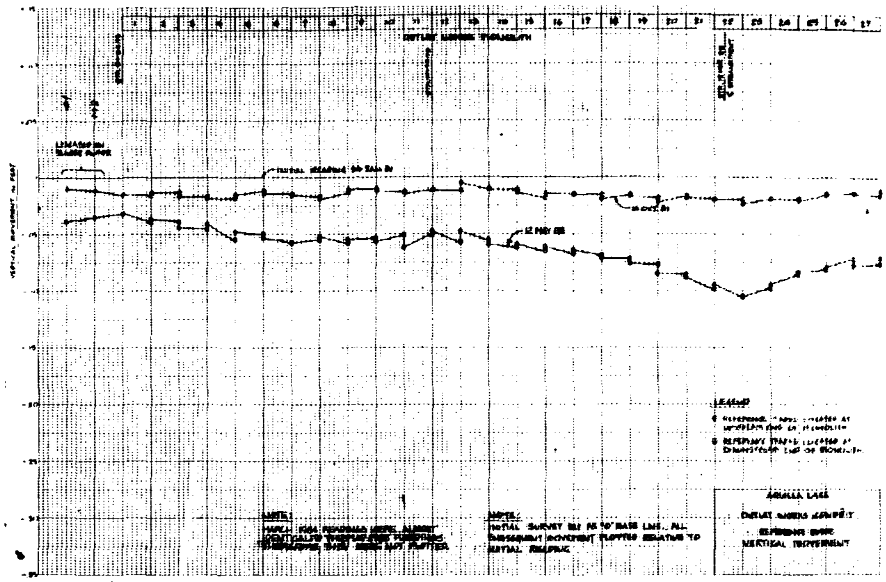
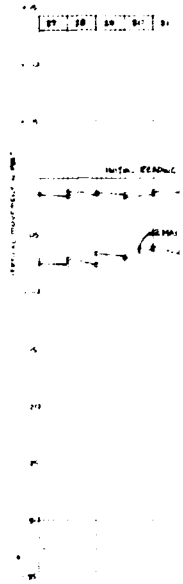
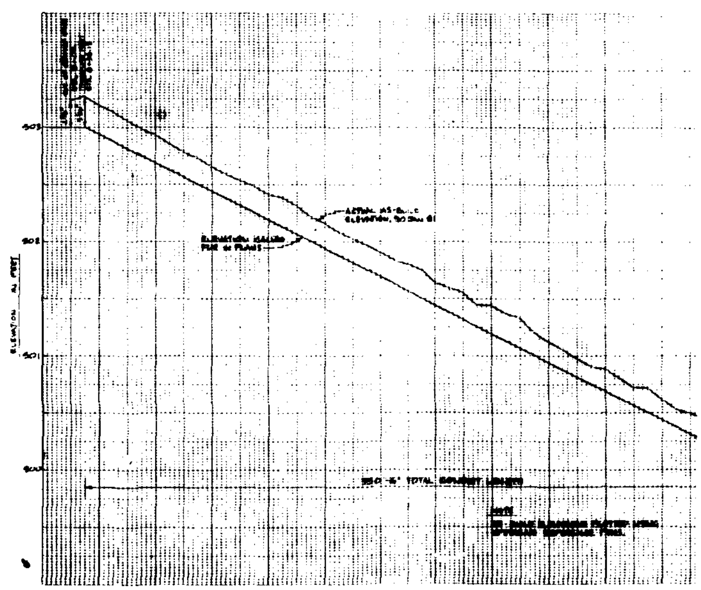
SEQUENCE NO

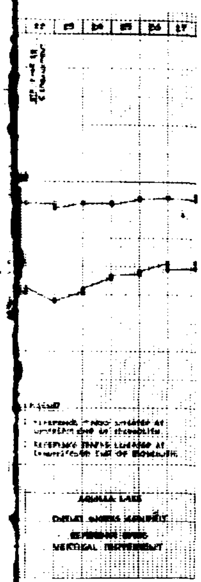
PLATE 21

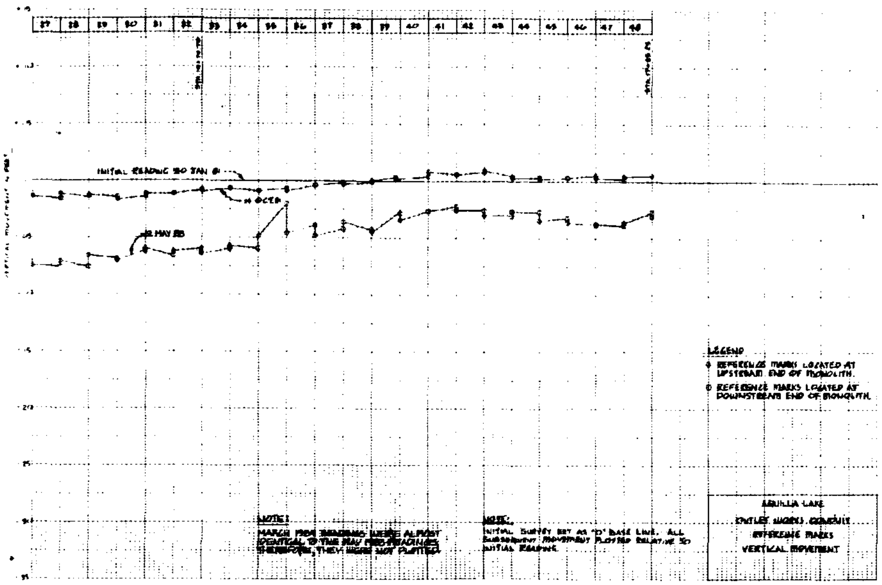


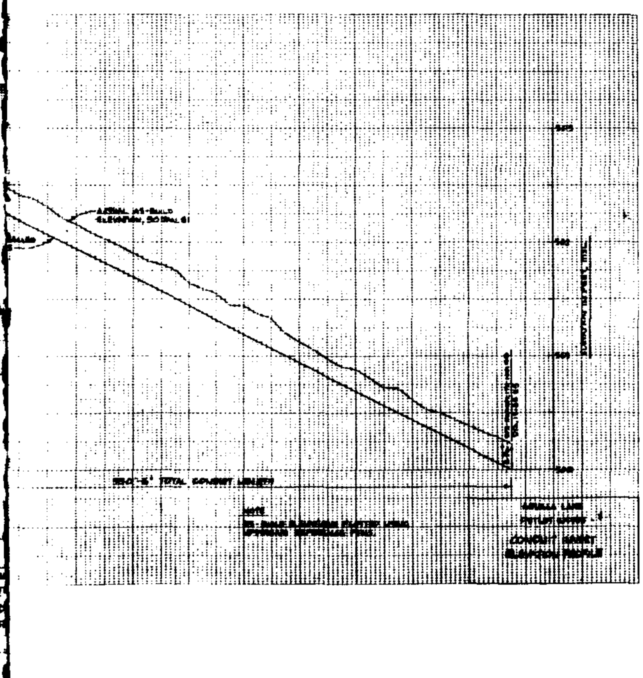


5
6
7
8
9
1983
1983
JUNE


VERTICAL MOVEMENT IN FEET
LEGEND
VERTICAL MOVEMENT


ELEVATION IN FEET







SYMBOL	ACTION	DATE	DESCRIPTION OF REVISION

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY: N BENNETT, R GRISWOLD
DRAWN BY: K. BROOKSHIRE
REVIEWED BY: T SCHMIDT

AQUILLA LAKE
AQUILLA CREEK, TEXAS

OUTLET WORKS
CONDUIT REFERENCE MARKS
AND ELEVATION PROFILE

SUBMITTED BY: H.E. KARKS, ENGINEER

INV NO | DATED
CONTR NO
DRAWING NUMBER | SHEET NO OF
SEQUENCE NO

PLATE 63

Photo 1 July 1983
Aquilla Dam, looking west along upstream side of embankment.

Photo 2 December 1982
Completed spillway, looking upstream

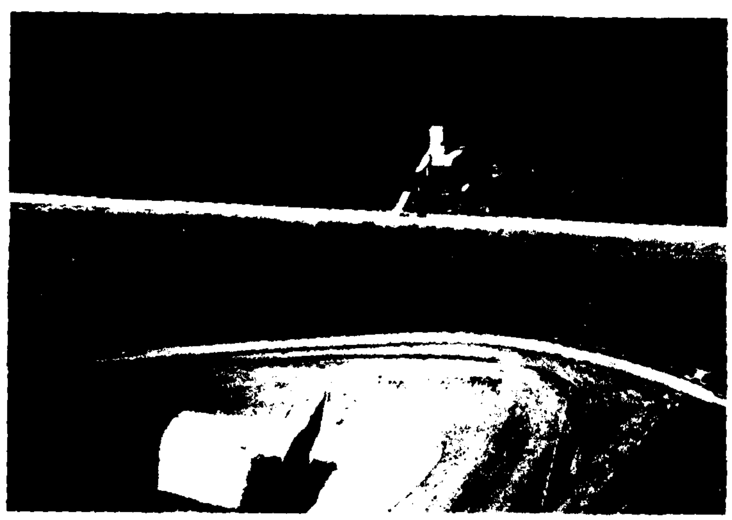


Photo 3 December 1983
Outlet works looking upstream

Photo 4 January 1982
Mucking-out operation at Aquilla Creek channel

Photo 5 February 1982
Foundation preparation and backfilling in Aquilla Creek channel

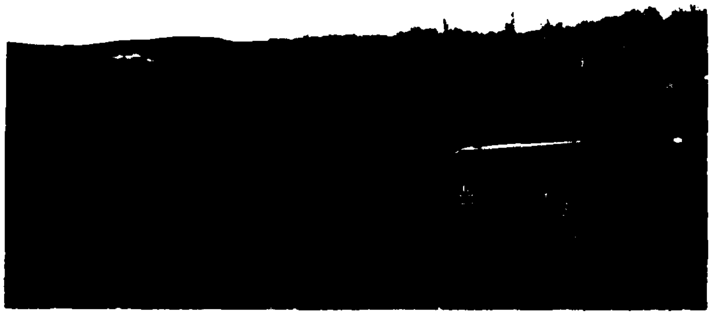


Photo 6 February 1982
Backfilling in Aquilla Creek area looking downstream

Photo 7 March 1980
Fill placement operations at right abutment of Aquilla Dam

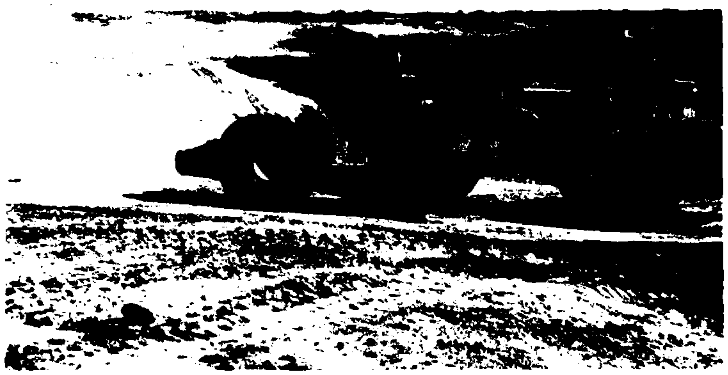


Photo 8 February 1982
Fill placement operations at right floodplain abutment of Aquilla Creek.

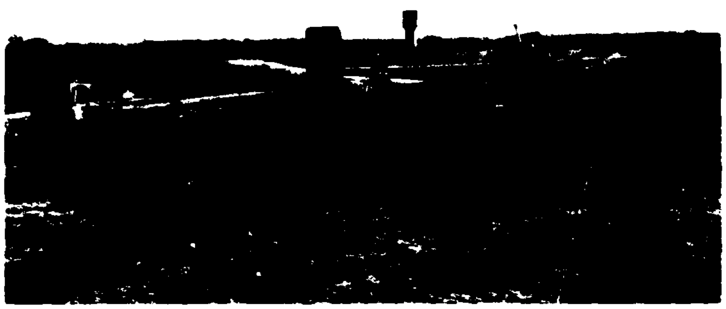


Photo 9 November 1981
Fill placement in random and semi-compacted zones for Aquilla Creek floodplain embankment.

Photo 10 April 1982
Fill placement operations in closure area

Photo 11 August 1981
Sheepsfoot rollers processing material in random fill zone of dam

Photo 12 September 1981
Pre-watering in borrow area

Photo 13 August 1981
Loading of material removed from spillway excavations

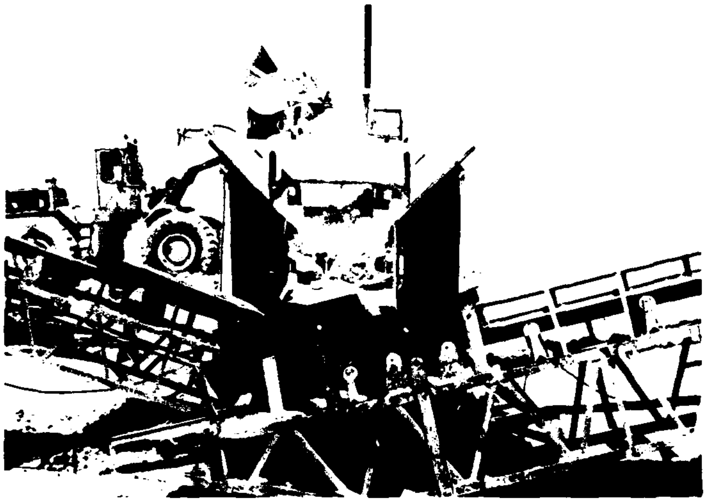


Photo 14 March 1982
Processing of 12" stone protection materials

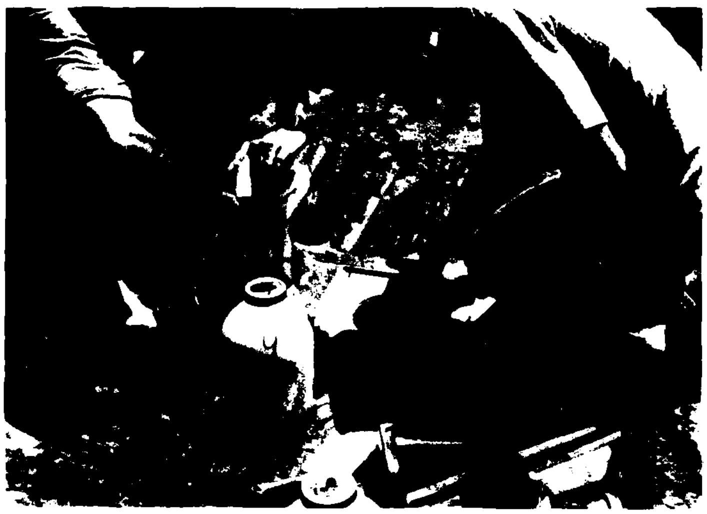


Photo 15 August 1981
Sand cone density test in inspection trench

Photo 16 April 1983
Upstream slope protection on initial embankment

Photo 17
Display of materials for an open system piezometer installation. Notice the 2-foot long porous plastic tip attached to the 3/8-inch diameter PVC riser pipe, the bag of filter sand, and bentonite pellets for the seal.

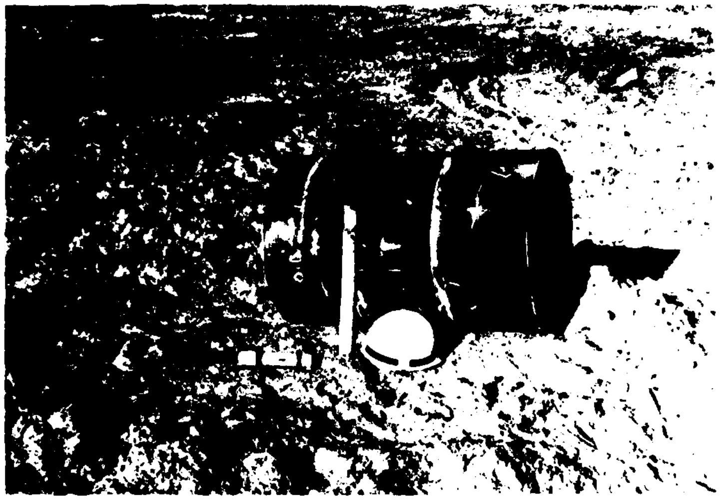


Photo 18
View of an open system piezometer after installation. Notice the inner 3/8-inch PVC riser pipe with vented cap and the outer 1½-inch diameter steel protective pipe.

Photo 19
View of piezometer showing temporary instrumentation protection, consisting of an earth mound and painted barrel.

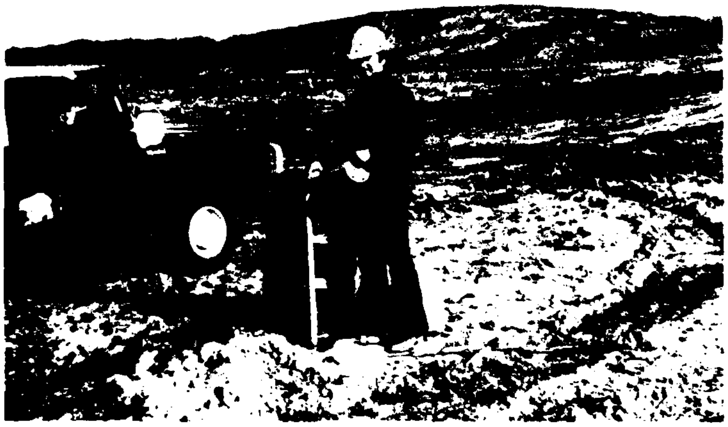


Photo 20
View of an open system piezometer being read by probing with an electrical water level indicator.

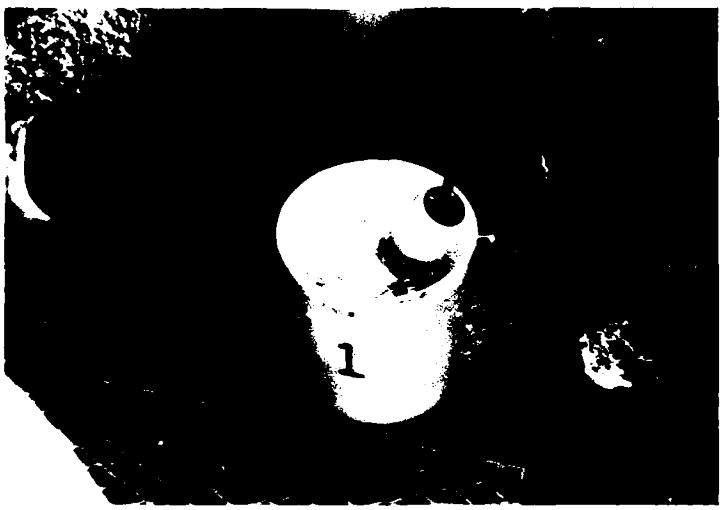


Photo 21
View showing a pneumatic piezometer transducer being maintained in a saturated condition with de-aired water prior to installation.

Photo 22
View of pneumatic piezometer transducer prior to being lowered into drill hole. The white portion is the high air entry filter.

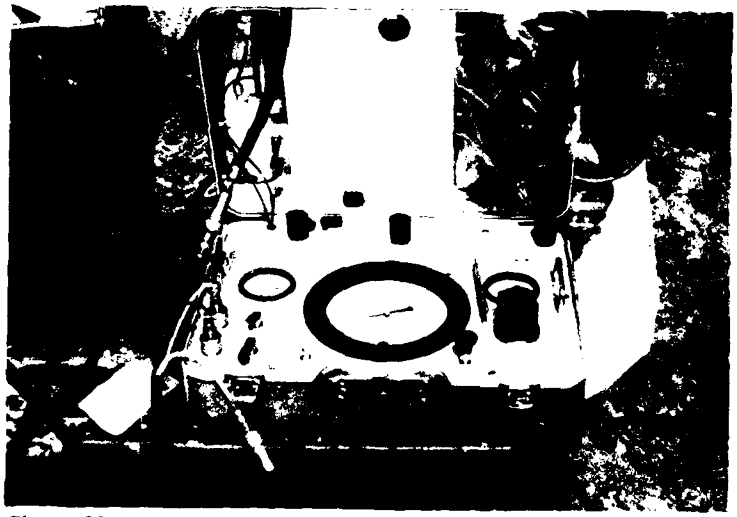


Photo 23
Portable pneumatic piezometer reader. Note the 4 tube leads encased in protective plastic that go from transducer in bottom of hole to reader at surface.

Photo 24
View showing a phase of the inclinometer installation. Air hose shown is connected to vibrator used to densify sand backfill around the blue PVC inclinometer casing shown in the photo.

Photo 25
Preparation to read an inclinometer. The sensor probe that attaches to the cable is not shown. Note protective fencing and protection steel casing.

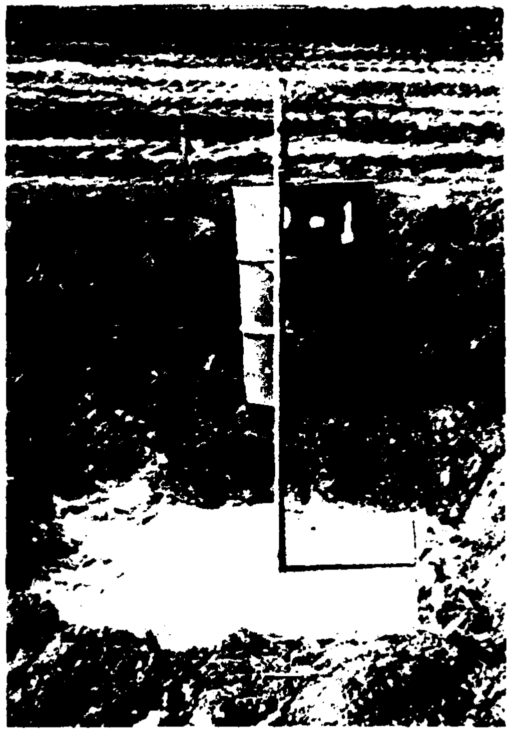


Photo 26
Settlement plate on prepared embankment foundation. Note the 3'x3' steel base plate and 1-inch diameter galvanized steel riser pipe. Not shown is the outer 2-inch diameter galvanized steel protective pipe.

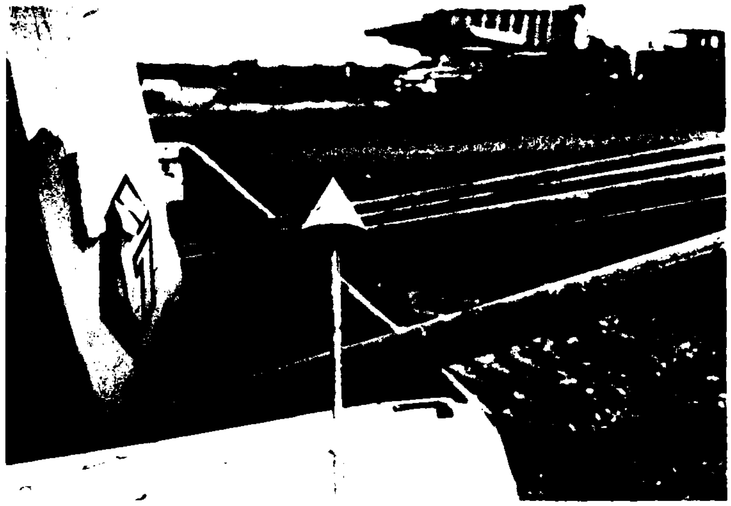


Photo 27
View of cone-tipped rod and outer protective pipe used to construct the deep bench marks for the completion contract.

Photo 28
View of deep bench mark after installation of cone-tipped rod and outer protective pipe. Elevations are established by measuring top of inner rod which does not move.

END

DATE
FILMED

7-86

DTIC